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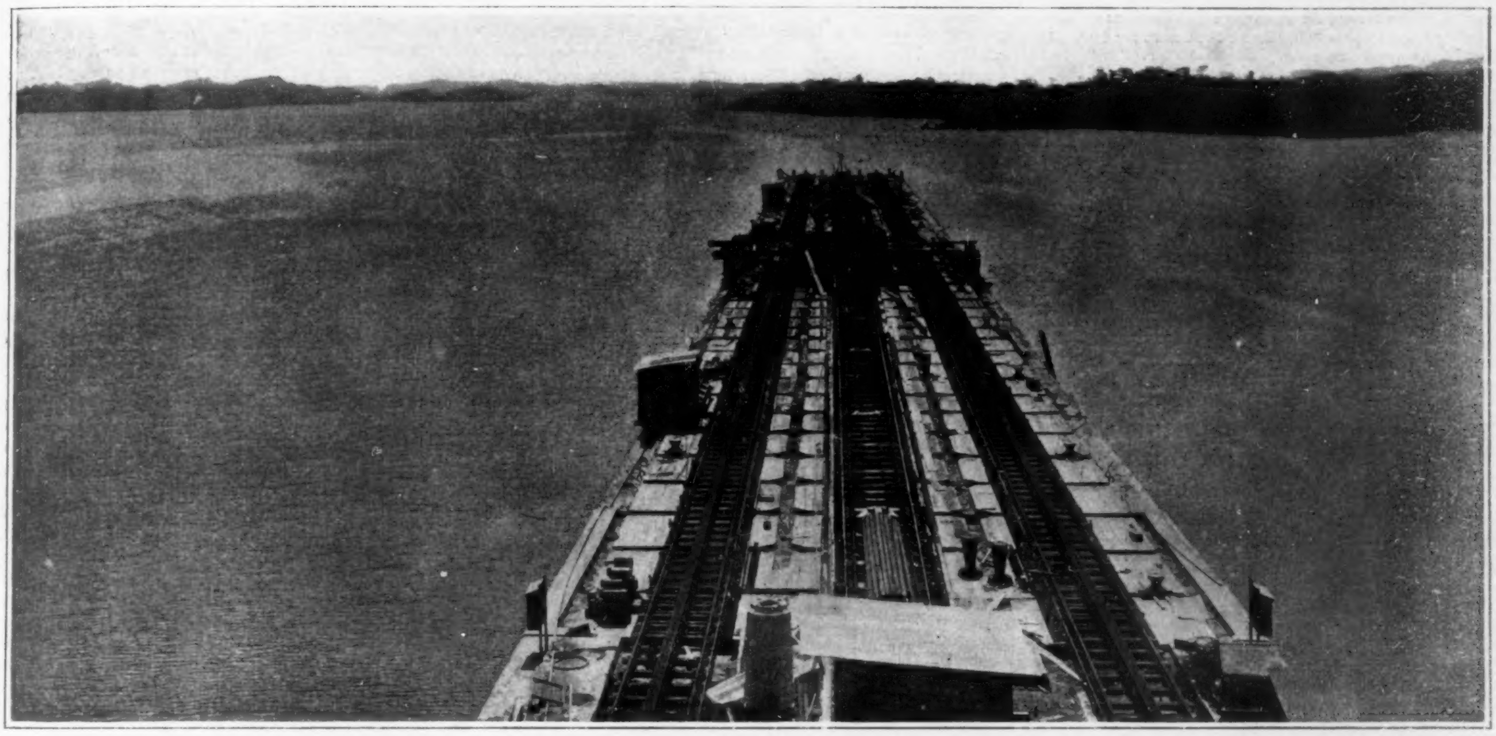
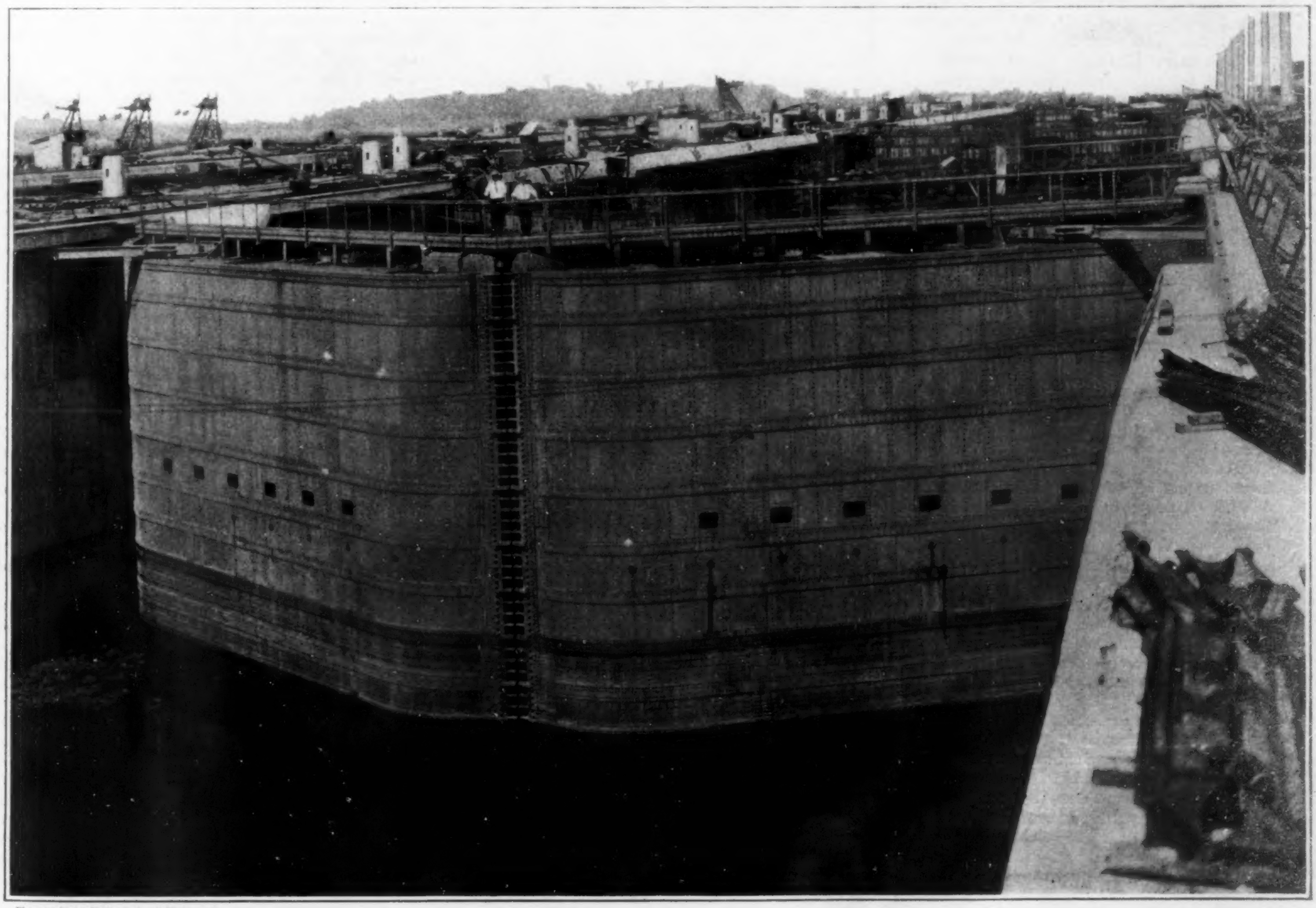


Gatun Lake and the south approach wall of Gatun locks. This artificial inland sea will cover nearly 170 square miles of the Chagres Valley.



Photographs by Underwood and Underwood.

The upper guard gate at Gatun, the first to be completed. In front is the water of Gatun Lake.

SOME RECENT VIEWS FROM THE PANAMA CANAL.—[See page 432.]

SCIENTIFIC AMERICAN

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

Science and Journalism

IN an excellent address delivered before the School of Journalism of Columbia University, and abstracted in a recent number of the *Independent*, Dr. Edwin E. Slosson lays an unerring finger upon the inadequate presentation of scientific discoveries in the daily press. Although the staff of every large newspaper includes such specialists as a dramatic editor who confines his attention to the plays of the day, a sporting editor who limits himself to a special field, a financial editor who reviews the course of the stock market, and a literary critic who gives his opinions on new books, no publisher has as yet thought it worth while to entrust the chronicling of scientific achievements to a competent journalist. Yet the real news of the day is often scientific news. Because the newspaper records industrial and scientific happenings in a slipshod way, we find it wofully behind the times. Thus, radium was not discovered by the newspapers until three or four years after the scientific papers of the world had marveled at its strange phenomena. Only now is the newspaper reader becoming acquainted with Mendel's laws, although the biologist has applied them since 1900. The principles of efficiency engineering and the astonishing success of the Taylor system had been set forth in engineering periodicals fully two years before they were enunciated by the daily press. At this rate the intensely fascinating papers which Sir J. J. Thomson recently delivered before the Royal Institution will find their way into the Sunday supplements some three years hence, although no more dramatic scientific announcement has been made in many a day.

When the newspaper does take up a scientific achievement of epoch-making importance, it usually distorts it beyond recognition, as Dr. Slosson points out. This is to be attributed partly to the ignorance of the staff writer to whom the presentation of the achievement in question is entrusted, and partly to the "human interest" standards by which editors of newspapers judge all writing. To be sure, nothing is so interesting to man as man. But is that any reason why his scientific work should be minimized and even misrepresented? Is it more important to record the fact that the man who discovered synthetic rubber is probably bald and wears spectacles than to tell in plain simple terms how genuine rubber can be made from raw materials with which everyone is familiar?

But whatever may be the faults of the average newspaper, the scientist is in part responsible for them. "The public does not know what is being accomplished in the laboratories," Dr. Slosson assures us he once said to a distinguished scientist. "Why should they?" was the retort. "It is none of their business."

This attitude Dr. Slosson seems to approve. But is it correct? Admitting that it is the business of the newspaper to employ a competent scientifically trained man to write on important technical discoveries, is it not also the duty of the university and the laboratory to circulate sound information on science? University settlement work finds its counterpart in correct simply worded newspaper reports of work performed by distinguished scientists. Institutions such as the Carnegie Institution of Washington could vastly increase their influence by popularizing the results of their investigations.

It is an unwritten law—perhaps a written law—that a reporter sent out to obtain an interview must not come back empty handed. The refusal to grant interviews often leads to a species of misrepresentation that does the scientist and the institution with which he is connected incalculable harm. Ten minutes or even half an hour of elementary exposition would often spare the university professor the annoyance of reading outrageous statements attributed to him. During the halcyon days of Halley's comet in 1910, when that historic body was being sadly maltreated in the newspapers, about eighteen reporters camped on the ground of one of our largest observatories. Their clamor for information was met with the assurance that Halley's comet was none of their business. Newspaper photographers requested members of the staff—some of them astronomers of international reputation—to pose at the eye-piece end of a huge telescope, and received a flat refusal, in accordance with the well-established scientific custom in such cases. What happened? An ingenious photographer asked the entire university staff to pose on the front steps of the observatory, which they did. That seemed harmlessly unastronomical; but it was enough. One of the most distinguished members of the staff was depicted the next day in a newspaper with a circulation of 300,000, seated at the eye-piece end of his instrument, gazing penetratingly at Halley's comet! His picture had been cut out of the staff photograph, pasted on a picture of the telescope, and the whole photo-engraved. To be sure, it was a very bad piece of work from the astronomical standpoint—totally incorrect and ludicrous. But it answered the requirements of the daily newspaper. How much better it would have been to have posed in the very first instance.

But what guarantee has the scientific man that even though he has taken the trouble to explain himself as simply and as clearly as possible, his views will be correctly presented? That, we must admit, is a serious but not an insuperable difficulty. The heads of great corporations employ their publicity departments in order to make announcements in the press. Our leading universities also have their publicity departments, which are now engaged chiefly in trying to attract more students, but which might be similarly employed. A university professor whose views on a given topic are asked should be able to refer his inquirer to the publicity department of his university. There the reporter ought to receive a typewritten statement, previously approved by the professor in question, which is to be published without any change. If this strict prohibition is ignored, that particular newspaper need expect no further courtesies. Our own experience with newspaper men has convinced us that they respect written statements.

The sooner scientific men discard the high priest attitude toward the reporter, the sooner that they supply him with simply and carefully worded statements which he is entitled to receive, the sooner will we be rid of a pernicious form of journalistic misrepresentation.

Social Problems and Eugenics

SCIENTISTS do not perform experiments in eugenics. They do not have to. The human race does all of that for the needs of science, and sad to observe, a great deal more. Such is the sentiment expressed by Dr. Charles B. Davenport, director of the Carnegie Institution's Station for Experimental Evolution at Cold Spring Harbor. He preaches no doctrine of scientific mating as opposed to the marriage of personal choice; instead, he and his associates cull data for correlation and deduction, purposing the ultimate publication of results which will assuredly further the science of eugenics and in turn benefit humanity. This Eugenics Record Office aims to be the country's clearing house for an investigation of race, of heredity of blood lines; and from this station is issued to all desiring it personal advice as to the suitability of marriages and the probabilities of inheritance. The applicant will receive a series of blank records to be filled out. Thus far the data collected by this office have been mainly of abnormal types—feeble mindedness, the inheritance of epilepsy, the inbreeding of degenerate strains; but this has been because such information is easier to get. The collection of "normal data" has been difficult, because a number of people have imagined eugenics to be concerned only with imbeciles and degenerates. Dr. Davenport aims now to collect from whosoever may send names, information about normal people, the talented, the genius, even the respectable, the right-minded and the right-moraled; and it is his hope that the American citizen's idea of social duty will include the recording and depositing with the Record Office of full information about his "family tree."

This Record Office is but two years old, yet thus far such facts as the following have been established: If two epileptics marry, their children will all be epileptics; the same is true of two imbeciles. If an epileptic or one insane married a normal individual, one half or one fourth of the progeny will usually inherit the parents abnormality; the others will probably be normal. A recessive trait (one present in undeveloped germ form and never becoming active in a given individual) may remain recessive for generations, but will very likely become active when it meets a like trait—recessive or not. The marriage of cousins is not bad in itself if both families are of sound stock; but such marriage will naturally bring out any common traits, and intensify weaknesses, recessive or otherwise. The redhaired are markedly antipathetic and seldom marry those having red hair. A good environment strengthens good traits, but will not guarantee the conquest of a bad inheritance. Love, in a mature and sensible human being (is ever a human being, however mature, sensible in these premises?) may be in itself a eugenic choice; the fact of two wholesome persons wishing to spend their lives together may be founded on instinctive traits that will make for a good inheritance; but love offers practically no more than an even chance. (Nevertheless the eugenist, wise man that he is, would not do away with love; but would combine with it, if possible, common sense and forethought.) Marriage with an individual of bad blood will tend to drag down the inheritance of good blood; imbecility is often introduced into "bloodlines" that have hitherto been good. One's inheritance cannot be judged by a consideration of the parents, for normal parents may have abnormal, even criminal children; the inheritance must be traced back for generations, and the records of cousins, uncles, aunts, brothers and sisters must be examined; one does not inherit from his parents, but from the family germ plasm.

The work of the Eugenics Record Office is, in brief, to learn how every characteristic behaves in heredity as to eugenic experiments: The world is full of the latter; there are as many experiments in eugenics as there are child-bearing marriages, as many "experimental results" as there are children born. The ordinary parent may take chances as to his children (and oftentimes does) that no breeder would take with animals. It was asked "if they were going to have a farm up there in the woods and make experiments with all sorts of freaks;" no, it was answered, such experiments, melancholy to relate, are all too many of them constantly being made. And Dr. Davenport and his associates will try to show the people who have made them what can be done with them, and how to prevent some of them in the future.

So the eugenist would have love and the "eugenic principles" go hand in hand in the marriage of the future, for happier homes and healthier children and the minimum of insanity, the hereditary degenerations, pauperism and crime. And the object of the Eugenics Record Office succinctly is to "serve eugenic interests in the capacity of a repository and clearing house; to build up an analytical index of the traits of American families, to train field workers to gather data of eugenic import; to maintain a field force actually employed gathering such data, to co-operate with other institutions and with persons concerned with eugenic study; to investigate the manner of the inheritance of specific human traits; to promote and to aid in the organization of new centers for eugenic research and education; to advise concerning the eugenic fitness of proposed marriages; and to disseminate eugenic truth."

Should Patent Office Fees Be Increased?

IN its admirable report on the Patent Office, President Taft's Commission on Economy and Efficiency makes the recommendation that the present Government fees be increased. There seems to be a feeling that the Patent Office examiners perform very arduous work for very little money, and that a large number of very narrow patents are granted which must inevitably be declared invalid if they are subjected to a validity test in an infringement suit.

We have not yet seen a satisfactory reason for increasing Patent Office fees. A sum of about seven million dollars has been turned into the Treasury of the United States by the Patent Office. No other institution of the Government has made a profit year after year, so consistently, and piled up to its credit so formidable a sum. An increase of fees is surely not justified because the Patent Office is doing its work too cheaply.

It is argued that patents are so easily obtained that devices which do not involve real invention are patented. Hence a certain class of patentees who contribute but little to an art which they seek to enrich, should be discouraged. But this is a two-edged sword that cuts both ways. If the man of small inventive ability is discouraged by placing financial difficulties in his way, so is the genius. Moreover, it is the primary object of every sound and liberally framed patent law to encourage and not to thwart the inventor.

Regard this recommendation of the Commission from whatever angle we will, it is impossible to justify any measure which seeks to burden inventors with needless costs.

Electricity

A 75,000 Gauss Electro-magnet.—In view of the scientific results which are obtained with the extremely powerful electro-magnet (50,000 gauss) installed at the Zurich Polytechnicum upon the designs of Prof. Weiss, it is now proposed to construct a still larger one at Paris, by Messrs. Weiss and Cotton, which will reach as high as 75,000 gauss and is to use electric current to the extent of 250 horse-power. The estimated cost of the magnet is no less than $40,000. It will be placed at the disposal of all scientists who are engaged in researches which require a specially strong magnetic field.

Metal Filament Street Lighting.—A test was recently made in Switzerland to determine the relative efficiency of arc lamps and metallic filament lamps for street lighting purposes. Two streets of equal length were lighted, one with the arc lamps and the other with the metal filament lamps. The arc lamps were of 10-ampere capacity and the incandescent lamps were of 500 candle-power. The choice between the two forms of lighting was left to twenty-nine trolley-car motormen. Twenty-five of these were in favor of the metal filament lamp, chiefly because it did not irritate their eyes as much as the arc lamp.

Emergency Lighting Plant for Ships.—To swell the horrors of a sea disaster at night the lights are apt to be put out by the flooding of the electric generating plant. But is it necessary to depend upon a plant located where it is liable to be flooded? Experiments are being made now on a large British vessel that is under construction, with a gasoline electric plant that may be placed on the bridge deck. This set will not only supply the light, but the wireless telegraph apparatus as well, so that the occupants of the vessel may be supplied with light and the means for calling for assistance until the very moment of complete submergence of the vessel. This generating set will be used only in emergencies.

Electric Control of Furnace Stoking.—A number of the recently built battleships of the French fleet are fitted with a very effective apparatus for securing a regular stoking of the furnaces, on the Niclausse system. In the engine room is an electrical device at the engineer's hand which sends automatic signals to the furnace quarters a certain number of times an hour in order to control the stoking. This is indicated by a luminous board in the furnace quarters having a panel for each furnace, and when the automatic signal comes on, an electric bell rings and the panel lights up, indicating for instance five shovelfuls in furnace No. 1, and so on in turn for the other furnaces. The amount of the coal feed and also the frequency of firing can be varied at times according to need by properly setting the apparatus.

Oil-engine Generating Plant.—One of the most successful electric tramway systems in the north of Italy has lately been installed at Parma. This called for the erecting of a central station of some size in order to furnish the current needed for all the tramway lines running through the city, and it is worthy of note that gas or oil engines are used for this plant. One of the engines is of the new Diesel type, and runs with heavy oil as fuel. This oil is vaporized by a compressed-air spray and thus furnishes a gas which runs the engine on the explosion principle. The new 500 horse-power Diesel engine installed in the Parma station ranks among the large sizes yet to be built and is of the upright type with four cylinders. Coupled to it is the dynamo which furnishes the current for tramway use. Other dynamos in the station are run by gas engines which work upon producer gas.

Milan-Varese Electric Railroad.—According to the most recent information about the reorganizing of the Milan-Varese electric railroad in order to provide for the needed increase of traffic, the State railroad department, to whom the railroad belongs, decided to purchase a supply of current from a Milan electric plant, and now adopts the 3-phase system at 40,000 volts upon a line running from the electric station to the railroad. Along the line there are erected seven substations which take the place of the four old ones, and all the substations were built anew so as not to stop the traffic while the work was going on. Owing to rapid work it was possible to open the new stations last summer. They have an electric outfit which receives the 3-phase, 40,000-volt current and changes it to direct current at 650 volts for use on the third rail of the road. The overhead wiring connecting up the various substations and the central station is about 60 miles long. The former Tornavento electric plant of small size is no longer used for the supply. Owing to the fact that the electric road passes through a very active industrial region, the traffic increased so much after the opening of the line in 1901 that a thorough change was needed. Heavier trains were also required, and this made it necessary to use a new type of electric locomotive which has recently been put into service and takes a 290-ton passenger train at 55 miles an hour, or a 450-ton freight train at slower speed. Owing to the advantage over the old locomotives for 150-ton trains this allows of keeping down to a reasonable number of trains per day and also of handling a heavy traffic.

Science

The New Capital of Australia, which is to be built in New South Wales, has been named Canberra (accent on the first syllable). The ceremony of naming the projected city and laying the foundation-stones of the "commencement" column was carried out March 12th by the governor-general and a numerous company of officials and military. The "commencement" column, which stands before the site of the capitol building, will, if possible, be composed of stones from all parts of the British Empire.

The Red Radish in Science.—An alcoholic solution of the skin of a red radish serves as an excellent indicator or test for acids and bases. In the presence of acids the colorless solution turns pink while with bases—alkaline solutions—it turns yellow. It is well known that many plant extracts such as litmus and animal products like the cochineal bug possess this property of developing marked colors with acids and bases, but no other indicator is so simply made.

Gelatin Protection.—Gelatin belongs to the class of protective colloids possessing the ability to surround minute particles of suspensions with a film that prevents their aggregation into precipitates. Since the formation of crystals is a growth from very small nuclei this process also may be hindered by a small amount of gelatin. Commercially this principle is applied in the making of marshmallows. The presence of a little gelatin does no harm, in fact it is a food, and it effectually prevents the crystallization of sugar within the marshmallow. Commercial ice cream contains some gelatin for the same purpose, to prevent the graininess of sugar crystallization. But further than this the gelatin surrounds the particles of casein in the milk with a protective film which hinders curdling and greatly aids digestion.

Aniline Dyes and Microbes.—That aniline colors have a marked action upon various kinds of microbes appears to be established by the recent work of S. Kriegler. He studies the effect of a certain number of aniline colors upon microbes such as typhus, coli and others, and finds that aniline compounds in general act to destroy microbes, this being even in greater degree than phenic acid. Of the different bacteria he examined he finds that the typhus bacillus is the most readily affected. On the other hand, he remarks that not only can there exist differences in microbe-destroying power between the different aniline colors for the same microbe, which are easily explained by diversity in chemical nature, but he also notes that the same color compound does not possess an equally strong power upon different kinds of microbes. In fact, a given aniline color substance may act as an antiseptic in destroying one species of germs without necessarily being active as regards another species.

Rock Paintings in Tunis.—Rock paintings of an interesting kind in the south region of Tunis are described by M. Henri Roux and published in the *Revue Tunisienne.* One of these was noticed on a rock wall in the Djebel Bliji, and it represents very likely a combat of men in conventional drawing and animals which it is difficult to identify. The age of this painting raises quite a controversy among scientists, and some think that it is contemporary with the Berber civilization, that is, intermediate between the stone age and the age of metals. According to this idea it belongs in the last part of the neolithic period. But M. Roux wishes to place it at a more ancient epoch and class it in the middle or first part of the neolithic period, it being due to a civilization which is more ancient than the Berbers, and M. Gobert also thinks that it is the work of negroid people to whom are due the flints of the neolithic age found in North Africa.

Effect of Manganese and Zinc on Spores.—The combined action of managnese and zinc upon the spores known as *aspergillus niger* forms the object of researches made by Bertrand and Javillier at the Pasteur Institute. Some time ago they found that each of these metals taken separately had a very striking effect upon the growth of these spores. The combined action is still stronger, as their recent researches show, and examining the results they find that the weight produced is greater when the two metals are used together than when only one of them is employed. It is seen that the productive effects of the two metals are added in these cases. Observing in what way the manganese is absorbed by the spores in the presence of zinc, they find that the manganese accumulates in larger percentage when associated with zinc than when alone, but the reverse effect does not seem to be proved, for in one test the same amount of zinc was absorbed regardless of the presence of manganese. Again the two metals have a catalytic action and thus influence the total absorbtion of mineral elements by the spore, and even small amounts of the metals will produce this effect. Even in the higher orders of plants, manganese fertilizer increases the amount of ash. The above results bear out the author's theory that the rare elements of the organism are far from being without physiological interest, and are not even to be taken as simple energy exciters of the protoplasm, but are in fact active elements of the cell and are catalyzers which are necessary for the chemical actions of living bodies.

Automobile

Brake Capacity and Efficiency.—As the result of recent experiments by Prof. C. B. Veal, of Purdue University, it has been demonstrated that for greatest all-around efficiency, the brakes of a car should be designed in the proportion of 1 square inch of braking surface to every 10 pounds of gross car weight. In this respect, efficiency is taken to mean sufficient retarding capacity to bring the car to a stop from full speed within a reasonable distance without excessive over-heating. Larger brakes, it is pointed out, are inefficient in that they are liable to lock the wheels easily, thus reducing retarding capacity and causing undue tire wear.

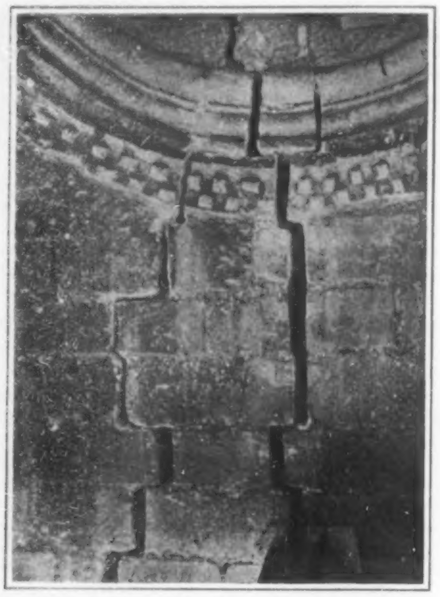
Improved Winter Wheel for Trucks.—To obviate the skidding proclivities of steel wheels on snow-covered roads and to eliminate comparatively expensive rubber tires, a manufacturer of commercial vehicles has developed a new type of tire composed essentially of rope fiber. The rope is cut into sections approximately three inches in length and after being impregnated with pitch the sections are subjected to hydraulic pressure to impart to them the required curvature and homogeneity. Afterward they are fastened within the steel felloe channels by the simple expedient of bending the edge of the channels inward. It is said that mileages upward of 6,000 can be obtained and that the rope tires are inexpensive and easily attached.

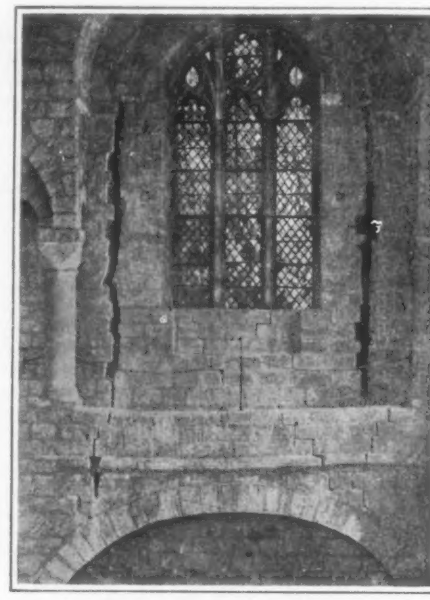
'Bus Lines for Rural Use.—It is the opinion that the present development of the gasoline omnibus, which is now such a success, is to have quite an influence upon the question of passenger traffic upon roads. Heretofore we have been familiar with light electric or steam railroads for use in the country districts, but it often happens that there is comparatively little traffic on such lines. In some cases, the estimated profits from such roads are not enough to warrant a great layout of capital, so that here the power wagon omnibus will fill the needs in the best manner. An example of this is seen in Italy, where the 'bus lines are developing considerably throughout the country, so as to avoid sinking a great amount of capital which it would be difficult to secure. The present question applies to local traffic as well as to tourist lines.

Benzol as a "Corrector" of Fuels.—Great as is the attention that has been directed toward benzol abroad as an alternative fuel for gasoline, engineers would seem to have overlooked the fact that it is as a corrector of the heavier distillates that the coal-tar product really is most valuable. It has given a great deal of satisfaction alone, it is true, but its continued use results in comparatively heavy deposits. Combining benzol with kerosene, on the other hand, improves both fuels, for it has been demonstrated by experiment that where only mediocre results can be obtained with kerosene alone, the addition of from 10 to 50 per cent of benzol materially improves both the efficiency and the economy of the engine. A possible explanation of the fact might be found in the greater volatility of the benzol, which thus assists in the vaporization of the heavier oil, which in turn burns more cleanly, due to the greater portion of carbon introduced by the benzol.

Warning Conveyed by Engine Starters.—Despite the very evident advantage of the many forms of engine starters which during the past year have sprung into such prominence, particular reference being made to electric devices, their use may conduce to higher instead of lower fuel bills unless due care is taken. That is to say, it is such a simple matter to start the average engine with such a device, the owner easily may overlook the fact that his carbureter is not properly adjusted for greatest efficiency, and this is particularly so with the varying densities of present-day fuels. Where the old-fashioned hand crank is used, the effort required to start the engine may serve as an indication of the adjustment of the carbureter, for proper adjustment means easy starting. With the coming of the engine starter, however, this means of judging of adjustment, even if it is comparatively rough, is lost.

New High-speed Gasoline Engine.—A new type of internal combustion engine, designed to run at the extraordinary speed of 4,200 revolutions per minute, has just been put on the market by an English manufacturer. While it is chiefly intended for aeronautic use, a similar model for automobile use is in preparation. The engine has eight steel cylinders of 2½-inch bore and 2¼-inch stroke, arranged in V shape on a tubular steel crankcase. On the end of the crankshaft is a spur gear which drives a large reduction gear having a ratio of six to one. The cylinders are set on the crankcase in staggered fashion. The motor develops fifty horse-power at the normal speed of 4,200 revolutions per minute, and weighs complete only 112 pounds; it works with a compression of eighty pounds per square inch. The engine was designed by Granville E. Bradshaw, who a few months ago turned out a motorcycle engine of the two-cylinder opposed type, which ran at 6,500 revolutions per minute and developed 13 horse-power.


Parting of the north wall in the north transept.


Serious cracks in the south window, east side.


Bad break in the west wall of the north transept.

Saving a Cathedral With a Diver

How Winchester Was Furnished With a New Foundation

By J. W. Overend

ONE of the earliest and most famous of English cathedrals is Winchester, second only to the historic Westminster Abbey in London as a national shrine. It was built by William of Wykeham, statesman, prelate, and a master-builder, in 1079. It took some fourteen years to build. To this day much of this Norman builder's work remains as he left it, particularly in the north and south transepts, in the cores of the piers, and the walls of the nave, and in the crypt. But some of it represents the reconstruction which was rendered necessary by the fall of the central tower in 1107.

The Normans were great builders, and they spent little time in designing, for they must have had their designs ready during a period of an initial building age never before witnessed in England. There might have been no time to dig properly for the foundations, or to find out if the ground on which they intended should be the base of the great cathedral, was safe or worthy to support the huge structure which reposed upon it.

The great minster must be reared, the long nave stretching ten, twelve, or even fourteen bays, the transept, the choir with its great apse must arise, and the lantern tower above the crossing of the transept upon its four great piers. It seems as if Wykeham thought his piers too large in area ever to be pressed down into the earth, and too mighty ever to be burst asunder. His confidence in his erections was complete and his faith unlimited.

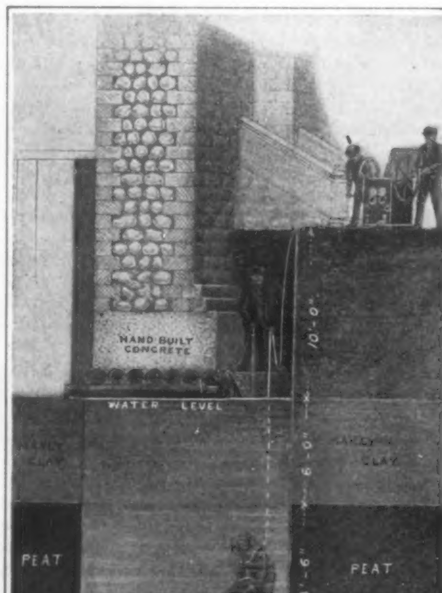
But the impression was false, and not lasting. The duration of very many of these massive works was short indeed, and the appearance of rock-like solidity altogether misleading. The huge piers are mere cases of external pick-wrought stones filled with rubble generally, imperfectly grouted together.

So it came to pass that the Norman central towers in most cases either soon fell down, or had to be rebuilt, or buttressed up, in order to avoid the ruin which their fall would otherwise have caused, and Winchester was among the cathedrals to have their towers rebuilt.

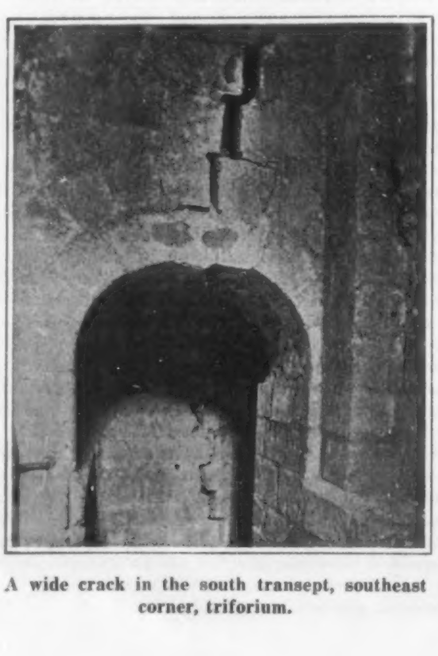
From the very beginning of the building of the cathedral it has had tremendous troubles, and its history has been marked with disaster owing to the unfortunate selection of a poor geological site of marl and peat on which to erect it. The appearance of ominous cracks in the walls, vaulting, and crypt caused those in power to take very serious steps in the spring of 1905 to remedy the defects, and to get at the root of the evil.

The work was taken in hand by Mr. T. G. Jackson, a distinguished English architect, whose work in the restoration of Eltham Palace, Bath Abbey, and other notable buildings of historic interest place him in the front rank of authorities on the preservation of old buildings.

The impression of the architect is that the pile began to settle as soon as it was finished, and it has, of course, been getting worse as years and centuries have come and gone. The walls, especially on the south side, had also bulged outward, the inclination from the perpendicular being in one part as much as two feet in forty-four, and in another place an inch in a foot.



Diver at work on the cathedral foundations.


A wide crack in the south transept, southeast corner, triforium.

The method of arriving at the cause of settlement has been unique, and in fact it is questionable if ever a cathedral has had a new foundation inserted after standing through a period of centuries like Winchester. Under direction of the architect, Mr. Jackson, a pit was dug on the south side of the eastern extension of the choir. Beneath a 10-foot depth of topsoil a marly clay of 3 feet thickness was reached, and in this stratum was found a raft of beech logs, placed horizontally in two cross layers. Below the clay was a layer of peat, and beneath that a gravel bed charged with clear water free from mud. This was the direct cause of the mischief. Water existed in the subsoil, and under the enormous pressure the peat had yielded, causing the walls to sink and to be thrust out by the pressure of the vaulting. The peat bed was found to be 8 feet 6 inches thick, but directly under the footings it was compressed to about 6 feet. The compressed peat really formed lignite. The building had sunk from 2 to 2½ feet.

In order to remedy the defective foundations the walls, vaults, etc., had to be carefully underpinned down to the gravel below the strata of peat. The water rose in the pit to the top of the clay deposit. The architect consulted Mr. Francis Fox, a celebrated civil engineer, whose success in solving the water difficulty in connection with the ventilation of the Simplon Tunnel in Switzerland stamped him as being the man to handle the Winchester problem. On his suggestion, a diver was employed, and the following mode of working was pursued:

First the walls of the cathedral were well grouted to fill up all the cracks. Then the foundations were attended to in sections of 5 or 6 feet at a time. Pits were dug through the topsoil, exposing the foundations. Then with the aid of ordinary excavating and light pumping the clay and some of the peat was removed until it was necessary to stop pumping, after which the diver entered the hole and removed the remainder of the peat, running drifts under the walls from 9 to 22 feet long. Bags of ready mixed concrete were then lowered down to him with which he paved the excavation, cutting them open to allow the material to spread over the surface. After four layers of bags were laid and the material had been allowed to set it formed a barrier to further inflow, and the water was pumped out of the pit. Then the foundation work was continued by ordinary masons and bricklayers.

It is worthy of note that the beech logs which formed the raft on which had slumbered the walls of a great English cathedral for centuries were in an excellent state of preservation, considering their position.

We are indebted to Messrs. Siebe, Gorman & Co., Ltd., for the above information, and for data from which the accompanying drawing was prepared.

The work is now finished. The cathedral will stand for future time, and remain one of those edifices which inseparably link the old with the new. England is proud of its old time examples of architecture, and particularly of Winchester, for it was here that the famous mandate was pronounced that the country should be called England and its people "The English."

Air Resistance to Falling Bodies

By A. A. Somerville

EARLY in the spring of 1912 there appeared in the SCIENTIFIC AMERICAN an advertisement asking for college men to make measurements of the time-rate of falling bodies over long distances of free fall. Such an advertisement as this, in which it was stated that the work might be done during vacation time, naturally brought a great number of replies, the writer of this article being one of those interested.

My correspondent and man back of the entire plan proved to be Mr. George Cleveland Hicks of Chicago, Illinois. Mr. Hicks is primarily a business man, a director in an enterprising corporation. Aside from his business interests he is interested in the laws of nature, and is willing to spend his money to study and have others investigate for him.

For several years Mr. Hicks has been interested in the subject of falling bodies, and especially in the rate of fall over long distances. He still has experimental notes taken twenty years ago, and adds to them all the while. This last year he has obtained the first real accurate evidence to verify his own private opinions on the subject, and he has had many different people at work for him in as many different places.

The laws of bodies falling under gravity alone, as first determined, are still used in practice to-day. The most commonly used equation is of this form:

$$S = \tfrac{1}{2} g\ T^2 \qquad (1)$$

Equation (1) reads like this—the space through which a body will fall in a given time is equal numerically to one half the value of the acceleration of gravity, multiplied by the time squared.

Now the value of the acceleration of gravity is equal to the force necessary to support a unit amount of material in free space, or it is the change in velocity that a body will acquire if allowed to fall from rest during one second; roughly this is 32 feet per second, so we will say that the value of $g = 32$ numerically, without attaching any time or space units to it as a physicist would do.

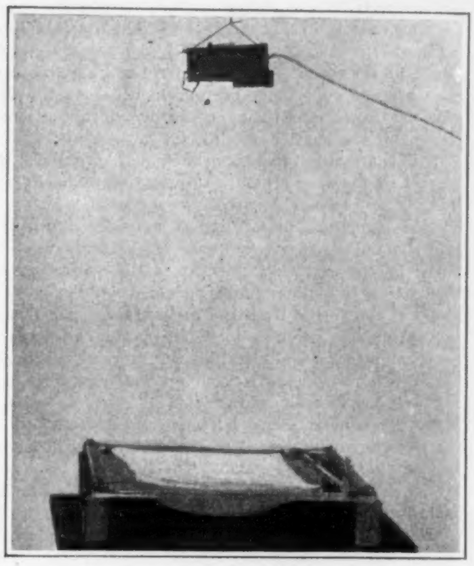
Now putting that value into our equation we have $S = \tfrac{1}{2}\ 32\ T^2$, and if we suppose a body falls during a time of 5 seconds then $S = \tfrac{1}{2}\ 32\ (5)^2 = 400$ feet. But if we try the experiment we will find that the body will not fall so great a distance in five seconds time.

There are two or more reasons for this—they are air resistance and air buoyancy. The latter is negligible unless very light bodies such as feathers or balloons **are dropped, but if metal bodies are dropped the** buoyant effect of the air is only about one hundredth of one per cent of the force of gravity, and so any retardation of the rate of fall of the metal body is negligible.

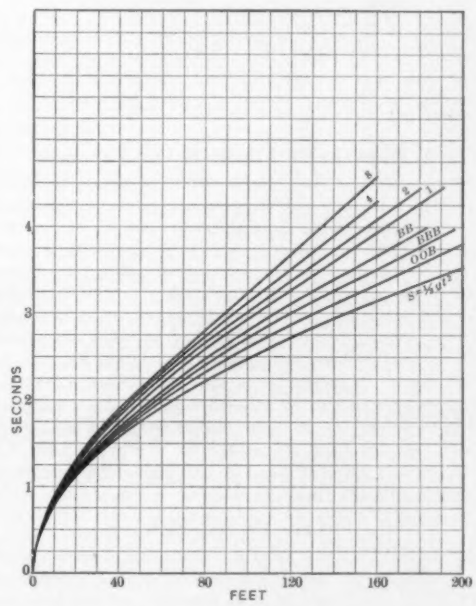
The other effect which causes retardation is that of air resistance. That is, the falling body must push the air out of its vertical path downward, and at high speeds this becomes a very considerable force. High speeds can be had in freely falling bodies only by using long distances. There are scarcely any data available on the subject. Prof. Hall of Harvard has done some work in his own laboratory. Attempts had been made, but without success, to secure the privilege of trying the experiment in the Washington monument.

The writer, with the assistance of others, worked on the problem this past summer at Toughannock Falls, New York. At that place there is a ravine with cliffs on either side 360 feet high. The gorge is 400 feet wide. A cable was stretched across from cliff to cliff and anchored. On this cable was a pulley which could be located directly over the middle of the gorge or at one side of the small stream at the foot of one of the cliffs. From this pulley a double line extended to the bottom, and by means of this line a steel measuring tape, a box with drop door to contain shot, marbles, bullets or similar objects to be dropped, and an electro-magnet with lead wires reaching to the ground, all could be raised to the height of the cable at the top. Through the lead wires extending to the ground a current could be sent through the electro-magnet, thereby opening the trap-door in the box and allowing the bodies therein to fall over a distance of 360 feet. Distance was measured accurately with the steel tape. Time was recorded on a chronograph or revolving cylinder covered with paper on which a pen marked. This pen was controlled by another electro-magnet in the same circuit as the one on the cable above, so that a signal was made on the chronograph at the instant the body started to fall. The falling body was caught in a sheet at the bottom at the end of the fall, and when it struck this sheet the impact was sufficient to jerk the sheet at the corners where it was fastened, and thus by means of electrical contacts make a signal on the chronograph through the electro-magnet operating the pen. Actual time of fall could in this way be read to the hundredth of a second.

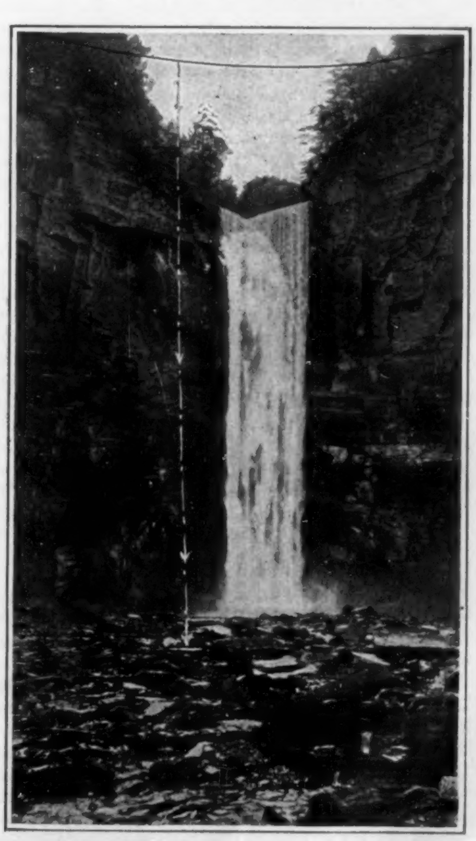
Knowing the value of gravity, the space and the time, substitution could be made in the equation, $S = \tfrac{1}{2}\ g\ T^2$ and the actual deviation from this equation determined.



Box from which shot was dropped and sheet in which it was caught.



Time of fall for shot of different sizes.



The Toughannock Falls and cable stretched across for use in the experiments with falling bodies.

Glass balls, loaded glass phials and shot of various sizes were used for falling bodies. Later in the summer more data were taken at two other places where air currents were not so troublesome.

A set of curves was plotted showing the time required for shot of different sizes to fall a given distance.

It is to be hoped that Mr. Hicks will continue these experiments, and so be able to furnish further data on the subject.

Moor-burning in Germany

A COLOSSAL "smoke nuisance," from which the greater part of Europe once suffered more or less, is now rapidly abating with the decadence of the time-honored German custom of burning the moors. This custom, together with certain atmospheric phenomena to which it gave rise, forms a curious chapter in the history of German agriculture.

About three per cent of the total area of the German Empire is moorland, i. e., a soil consisting of peat, formed by the partial decomposition of mosses and other vegetation, and in its natural state unfit either for cultivation or grazing. The problem of utilizing the moors, both in Germany and in the other countries of northern Europe, has received a wholly satisfactory solution in recent times, thanks to the efforts of numerous moorland experiment stations, moor commissions, societies for moor culture, and so forth. Several scientific methods of moor culture are now in vogue, and there is a large literature on the subject in German. The problem is, however, an old one, and was partially solved centuries ago by primitive methods, one of the most popular of which was moor-burning. The great stronghold of this custom, which was introduced from Holland at the beginning of the eighteenth century, was the district in the northeastern corner of Germany called East Friesland, and here it still flourishes to some extent.

The essential features of the process are as follows: The land is usually first drained by open ditches, in order to dry a shallow layer of surface soil. In the autumn the turf is pared off with large hoes, the sections being turned over or set on end, and allowed to dry all winter. During a spell of dry weather in May or June the clods of turf are piled in heaps and set on fire. The fire is generally started on the leeward side of the pile, in order to ensure slow and thorough combustion. The results of this process are that the land is cleared of waste vegetation, a layer of ashes is spread over the moor, and the underlying ground is improved in its hygroscopic and chemical constitution by the heating which it undergoes. The land thus prepared is generally sown at once to buckwheat. After the harvest the whole process is repeated, and another crop is grown the following year. No fertilizers are applied. It is found, however, that the productiveness of the land diminishes year by year, and after six or seven years the moor is burned "dead." It must then be abandoned, and requires 20 or 30 years to recuperate. As compared with the modern methods of thorough draining, rolling, mixing with the subsoil, and otherwise permanently reclaiming the moors, the burning process is so wasteful of land that it has generally been given up except in districts remote from settlements, where the cost of the land is insignificant.

One of the most serious objections to moor-burning is the huge volume of smoke which results from the smudging of the imperfectly dried peat. This smoke is carried by the wind for hundreds and even thousands of miles. There is a saying that "when the moors are smoking all Germany smells it," but this hardly expresses the matter fully; for there are many cases on record in which the smoke from the North German moors has been observed in the form of a characteristic haze—the so-called "dry fog" or "moor smoke"—as far away as Spain, Italy, and Greece. This phenomenon is analogous to the smoke-haze from forest fires so often observed over vast areas of the United States in autumn.

In the vicinity of the burning moors the smoke is a downright nuisance, and has led to the formation in Germany of a number of anti-smoke societies whose efforts have hastened the passing of this primitive custom.

Useful Cements

ONE of the simplest hard cements is the well-known mixture of litharge and glycerine made to a stiff paste. It sets hard as a rock, and is oil-proof. A solution of water glass mixed with powdered calcium carbonate serves the same purpose.

A mixture of boiled linseed oil and fire clay resists acid better than most cements, though sulphur melted with glass powder is also ranked as very resistant to chemicals in general.

A good stone cement is made by mixing two parts of magnesium oxide, one part of magnesium chloride, powdered stone to suit as a filler and water to make a stiff paste. Basic magnesium chloride is formed.

New Light on Diabetes

MOST people think of diabetes as a kidney disease. This is erroneous. Diabetes is a disease whose characteristic symptom is an excess of sugar in the blood. This excess, the kidneys work hard to remove. To hold them responsible is as absurd as to blame the thermometer for extremes of temperature!

Soluble sugar is a vital necessity to the organism, but an excess is a dangerous poison which must be excreted.

The latest investigations of sugar metabolism show that the formation and excretion of sugar depend on a very complicated and delicate balance of the operation of several organs, including the central nervous system, the sympathetic nervous system, the pancreas, the supra-renal glands, the pituitary body, the thyroid gland, and the epithelial bodies. Any disturbance of this balance, which is attained by a delicate adjustment of "controls," may lead to the presence of an excess of sugar.

The value of these discoveries, which are very clearly stated by Dr. L. Reinhardt in *Prometheus*, is inestimable, since they afford hope of an earlier diagnosis and prompter treatment of a particularly insidious malady.

The chief source of sugar in the body is the starch consumed in bread and other cereal food and potatoes and other vegetables. Only a small part of the sugar we need comes to us in soluble form, as of grape-sugar, milk-sugar, cane-sugar, and fruit-sugar. These enter the blood directly because of their solubility; but the starches, which are insoluble in water, must be acted on by digestive ferments and transformed into sugar before they can be thus taken up and carried to the various tissues. This is partly accomplished by the saliva, but chiefly by the pancreatic juice in the small intestine, after the food has passed the stomach. From here the sugar passes first to the liver, and afterward enters the general circulation, to be carried to various parts of the body, being especially required by the muscles.

"If now the provision of sugar exceeds the current demand, the excess is stored up, partly in the form of insoluble animal starch (glycogen), whereby water is eliminated, and partly in the form of fat. The latter is stored in the greatest variety of places; the former chiefly in the liver and muscles.

"Animal starch is formed not only from starch and sugar, but from albumen, when an excess of this is furnished by such food as meat and eggs; but the amount thus formed is insignificant compared to that from the so-called carbohydrates."

Hunger and labor both diminish these stores in the organs, the liver and muscles first answering the demand. The process is so neatly adjusted in the healthy body that despite the large variations in the amount of carbohydrates consumed, on the one hand, and in the output of energy, on the other, there is never a great excess or decrease, the percentage of sugar in the blood remaining steadily between the narrow limits of 0.1 per cent and 0.15 per cent.

It is only when the body loses its power of burning sugar in its tissues that the sugar content of the blood is unduly augmented, and must be removed. Naturally the kidneys, like other organs, may suffer degeneration through overwork.

"When, by reason of increased use of sugar, the sugar-content of the blood threatens to fall below the normal, the liver and other depositaries of animal starch, such as the muscles, receive the order to transform some of this into soluble sugar and supply it to the circulation. This message is transmitted by the so-called '*chromaffinic*' system, which is specially located in the supra-renal glands. The blood then brings the sugar to the place where required and gives it up to the needy cells. If the chromaffinic system fails of its function because of some affection of the supra-renal glands, as in Addison's disease, the sugar content falls below the normal."

But here another factor must be considered, in the action of the pancreas. This gland is antagonistic to the supra-renal glands, in that it exerts an inhibitory influence upon sugar formation in the liver and other depositaries. Hence, the pancreas and supra-renal glands tend to control each other, thus preserving the needed balance. But if the pancreas becomes diseased, while the supra-renal glands remain sound, the result will be an excess of sugar in the blood.

But both pancreas and supra-renal glands are themselves controlled by other regulators. The pancreas is subject to an inhibition from the thyroid gland. When this is unduly large the pancreas is checked in its function of limiting sugar production in liver and muscles. Hence, the too free metabolism of animal starch into sugar causes an excess of the latter and more work for the kidneys. "Consequently, we often observe the presence of sugar in the urine of patients suffering from an enlarged thyroid, as for example Basedow's disease, or 'goggle-eye.' This malady lowers the capacity to burn sugar."

Conversely, if the thyroid is insufficiently developed the pancreas is insufficiently checked in its inhibitory action on liver and muscles, with the result that the "limit of tolerance" for sugar is raised. In this case even a large superfluity of carbohydrates in the diet will not cause elimination of sugar, since the sugar content of the blood is diminished. . . .

"The supra-renal glands, on their part, are under the control of the sympathetic nerve system. The French investigator, Claude Bernard, showed nearly two generations ago that the sticking of a needle into a certain spot in the fourth ventricle of the brain was followed by the excretion of sugar in the urine, because the irritation thus induced passed over the *Nervus Sympathicus* to the liver and accelerated sugar formation. But this stimulus to the liver from the central nervous system goes by way of the supra-renal glands. . . . Claude Bernard's 'Puncture Diabetes' is in fact a purely supra-renal diabetes.

"To these correlations must be added the effect of the pituitary body, and that of the epithelial bodies of the *accessory* thyroid gland. The pituitary body acts in the same way as the thyroid, while the epithelial bodies (or epithelial corpuscles) act antagonistically.

"Hence, the enlargement of the pituitary, as seen in acromegaly and the closely related 'giant-growth,' occasions a lowering of sugar tolerance, precisely as does an enlargement of the thyroid; while on the contrary, the enlargement of the epithelial corpuscles causes an increase of sugar tolerance."

Even these elaborate reactions do not cover the full complexity of sugar metabolism, since some questions remain to be solved. But it is obvious that sugar in the urine may proceed from a great variety of causes, making the need of skilled diagnosis imperative.

A Remarkable Flight in the Far East

THE aviator Marc Pourpe made an aeroplane flight which is quite out of the ordinary during his stay at Singapore, flying in a brilliant manner across the island of Borneo, which is entirely covered with wooded tracts made up of cocoa and rubber trees, then flying above the Sultan of Johore's palace, this being situated on the other side of the strait, whose width is three miles. This flight is said to be the most dangerous which has yet been attempted, although the distance is only about 50 miles. It is also the longest aeroplane trip to be made in the tropical regions. The Sultan of Johore offered the pilot the sum of $600, and the Singapore Sporting Club raised a prize of about $2,400 for the flight.

Live Frozen Fish

TRANSPORTATION of live fish is an expensive matter from the fact that it requires from 1 to 4 gallons of water per pound of fish, according to the kind, so that a railroad car having 10 tons limit for the load can transport only one half to one ton of live fish. Messrs. Mir and Audigé now use a method of freezing the fish in blocks of ice, according to Pictet's experiments, and can now transport a large quantity of fish in a relatively small weight of ice. The fish are at first contained in a large amount of water, then while the tank is placed in a closed space, oxygen under pressure arrives upon the water, so that the greater part can now be drawn off and the fish remain in good condition in a very small amount of water, as the oxygen supplies their respiration. Freezing is now done by plunging the vessel with the fish into a refrigerating tank, and in this way an ice block is obtained in which the fish are frozen, but will come to life again when thawed out. The block is wrapped around with suitable coverings and on the outside is put a heat-protecting jacket, then the block is ready to be placed on the car. In practice, such blocks can be piled up in refrigerator cars whose temperature is kept near the freezing point. Upon arrival at their destination, the fish are put through a very slow thawing process, which lasts for about ten hours. The inventors claim that this saves heavy and bulky liquid and there are no complicated or costly devices needed, the process being a simple and cheap one.

Artificial Diamonds

A PARIS engineer, E. de Boismenu, claims to have produced minute diamonds by an electric furnace process, the largest of the specimens measuring nearly one tenth inch. Naturally the announcement of such an important discovery has made somewhat of a sensation and gives rise to some incredulity as well, but the author has now published a brochure on the subject in which he gives a very complete account of his method, for which he has taken a patent. We expect to give a description of the process and show some photographs of the specimens at an early date, but would mention at present that the specimens have been seen by some well-known scientists, also jewelers, and they identify them with real diamonds. Naturally they were put through all the necessary tests in this case. The process is based upon the electrolysis of calcium carbide in the electric furnace by the use of direct current, and the carbide is decomposed in such way that one of the poles becomes surrounded with a blackish and spongy substance in which a certain quantity of minute carbon crystals or diamonds are observed, and these are separated by pulverizing and washing the substance. The experiments were made on a small scale, as lack of means prevented further work, but the inventor expects to resume them soon. What is encouraging is that the size of the diamonds increases with the length of time the furnace is left running, so that there is reason to believe that much larger specimens can be obtained. The SCIENTIFIC AMERICAN will soon publish an article on the Boismenu process.

Preventing Bread from Getting Stale

FOR thousands of years mankind has been content with allowing its bread to get stale, and this fact has come to be considered unavoidable. It is the more surprising that researches by Dr. J. R. Katz at the Physical-Chemical Laboratory of the University of Amsterdam, should have shown that there is in point of fact no need for allowing our bread to lose its toothsomeness. When kept either at a very low or very high temperature, bread is in fact preserved "new" for some days at least, staleness being due only to the ordinary temperatures of bread storage and consumption.

In connection with Dr. Katz's experiments, bread was kept absolutely new for more than 40 hours at a temperature of 60 deg. Cent., while at a temperature of 30 deg. to 40 deg. it became only "half stale." At ordinary temperatures it of course grew rapidly stale, in order again to become "fresh" at temperatures below freezing point.

Dr. Katz accordingly recommends keeping the newly-baked bread at temperatures of 50 deg. Cent. and upward, thus keeping the crumb absolutely new, whereas the crust by absorbing water becomes limp and flexible. If the bread be then put back again into the oven for a short time the crust will give up its water, thus becoming hard and crisp as before. An even simpler course is preserving the bread in cold storage rooms kept at sufficiently low temperatures. If these rooms be sufficiently dry, the crust likewise remains hard and crisp so that the bread even after a considerable time is equivalent to new bread.

Apart from its importance to the housewife this process is of the highest economical interest, relieving as it does the baker of the necessity of baking his bread by night.

How to See Through Opaque Paper

A VERY remarkable experiment which any one can repeat with very little trouble has been unearthed by a contributor to *Prometheus*, in an old number of the *Mechanics Magazine* of the year 1829. Take a piece of paper of such thickness that, when it is laid upon a piece of printed matter, the characters just show through, but cannot be read. Placing it over a printed sheet, impart to it a circular motion to and fro, and to your surprise you will find that now you can read the print below the paper. It is rather difficult to explain this peculiar effect. The explanation offered in *Prometheus* is that the paper has a number of thin places in it, and by rapidly moving it over the print, every part of the printed matter is exposed in turn underneath one or the other of the thin places in the paper and thus the entire print can be read. However, that may be, the experiment is interesting and very simple, requiring for its performance only the simplest means imaginable.

The Current Supplement

GRINDING wheel sparks are not only a somewhat spectacular accompaniment of the use of the wheel, but may be turned to useful account, as their appearance gives a clue to the initiated of the character of the steel from which they are struck. This point is illustrated by R. G. Williams in this week's issue of the SUPPLEMENT.—It will be remembered that in 1907 the Quebec bridge over the St. Lawrence River collapsed while in the course of construction. The plans adopted for a new bridge by the Canadian government are critically discussed and compared with the author's own design of Prof. G. Kriswoschein of St. Petersburg. —Some deceptions practised upon the unwary buyer of scrap metal are laid bare.—A simple method of measuring the height of an aeroplane is described.—The concluding lecture of the series delivered by Sir J. J. Thomson on the Structure of the Atom appears in this issue.—A new vacuum gage of extreme sensitiveness is described by Irving Langmuir.—A. D. Watson writes on Calendars Ancient and Modern.—An important paper, "Problems in Wireless Telegraphy," by Prof. J. A. Fleming is presented in full.—Prof. J. Warren Smith's report on the rainfall in the districts affected by the recent floods is published in this issue.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

Inventors and Technical Schools

To the Editor of the SCIENTIFIC AMERICAN:

Mr. Kennedy's letter on page 287 calls attention to a most needed thing. The progress of any country depends largely upon developing new wealth, and your article on Inventors and Inventions quite clearly brings out this fact. Unfortunately, American manufacturers are not fully awake to this matter, or they regard the expense of development as beyond them, which in many cases it doubtless is. The Germans are doing much better than we in this respect. Possibly because labor is cheaper.

We have, however, means at hand that could be used if proper agitation and education is made along this line. I refer to our technical schools. Manual training is being adopted by many schools, so that the student is given practical work along with his theory. These students contain a large available supply of muscle and brains which could just as well be employed on new work as in doing more or less useless work, as often happens now. If inventors could arrange with the school to develop the invention, the school would get the advantage of its students' work on something that requires advanced thought, while the inventor would get the advantage of the apparatus, experience, and theories which the school can give him. I think some work of this kind is done now, but I do not know of any recognized, equitable plan under which it is done, nor of any arrangement for protection of the inventor, on which account he usually prefers to keep his invention to himself until perfected sufficiently to apply for patent. If the school could receive a certain percentage for developing the device and for assisting the inventor to market it, this matter could be profitable to the school and inventor both.

Saginaw, Mich. CHARLES E. DURYEA.

The Need of a Bibliographical Institute

To the Editor of the SCIENTIFIC AMERICAN:

Your editorial, "What the Rich Man Might Do for the Scholar," is very much to the point. You ask, "Why not found a bibliographical institute?" Perhaps the reason why it has not been founded is that it does not appeal to the imagination in the same way as does a library. But you are quite right in pointing to this as a matter of greater importance than the multiplication of libraries. An institute for bibliographical research, such as the writer has advocated for many years, would supplement and aid the work of libraries and would result in a national organization of what might well be called the foundation of all knowledge; for bibliography answers the question: "What do we know about this matter and how did we arrive at the present knowledge?" Anyone who tries to answer such questions will necessarily use *bibliography* as a means by which his problem must be solved.

It is now nearly twenty years ago that the writer, in a paper read before the New York Library Club and afterward published in the *Library Journal*, advocated an organization of bibliographical work through a pooling of the interests of a number of the larger libraries for the purpose of making their resources in many special fields more generally available.

Since then the subject has received the very closest attention on my part, and I have repeatedly brought it to the attention of libraries, bibliographers, and other scholars. From nearly all quarters the proposition has met with approval and interest; the need of a bibliographical institute in the interest of scholarship is fully appreciated by those who would benefit by it.

Men of wealth have been approached through various channels in an effort to find someone who would come forward to assist this important movement, but so far in vain.

An effort is now being made to interest business men in the subject. Efforts are being made to show that bibliography can be made of direct service to the business community. This circular has been sent out to a number of prominent business men in Chicago calling attention to the value of research along these lines for both agriculture, manufacture and commerce. A "Committee on Research Institute" has been formed for the purpose of promoting the idea.

While the latest endeavor has been made along the line of business, the intention of the writer is now, as it has always been, that the only limits to the scope of the proposed institute should be the actual needs of those who might seek its assistance.

The functions of the proposed Research Institute would be entirely practical. The institute staff would be in readiness to make researches into definite subjects at the request of those desiring special information; it would also try to anticipate the needs of inquirers, and compile references on subjects of actual interest in advance of demand.

The writer has often been asked what relation this proposed Bibliographical Institute would have to the other institutes of this kind, notably the Institut International de Bibliographie at Brussels, and the International Institut for Sozialbibliographie, and allied institutions, at Berlin. The answer is that it would supplement them and, as far as possible, utilize their material. The Brussels Institute collects titles of all kinds, from all sources and of all dates; the Berlin institutes collect titles from the current year on a limited number of sciences. The institute which the writer proposes would have for its object to collect titles from all sources and of all dates on a definite number of subjects, concerning which information is actually wanted.

While an institution of this sort should be independent, and not affiliated with another, for instance, one of our large libraries, it might very well be organized in connection with a new kind of library, a library for libraries, containing books and periodicals too expensive and too little used for the ordinary reference or college libraries to possess them. The establishment of such a library has been advocated several times.

If anybody who reads the above should be willing to assist in any way in furthering the interest of bibliographical research along the lines suggested, he should communicate with the undersigned.

AKSEL G. S. JOSEPHSON,
Chairman Committee on Research Institute.
Chicago, Ill.

The Fallacy of Flexible Fabric Wings

To the Editor of the SCIENTIFIC AMERICAN:

I have read with much interest Mr. Grant Linton's letter on aeroplane design in your issue of March 1st, 1913. In the present stage of the science every suggestion, if not too obviously absurd, is entitled to serious consideration. Nevertheless, Mr. Linton's reasoning seems to be based on such an astounding lack of knowledge of the commonest facts of aerodynamics, that I am forced to doubt the validity of his conclusions.

For instance, he tells us that the forces acting on his piece of fabric are its weight, downward, and the wind, backward, but he overlooks the third necessary factor to equilibrium, the upward and forward force of the cord or other sustaining means. How will he allow for this force in transferring his idea to an actual machine? Then he assures us that the air stream is flowing horizontally as it meets the forward edge of the fabric, apparently unaware that Montgomery proved, as long ago as 1905, by using streams of water sprinkled with light chaff to indicate lines of flow, that a current approaching a surface inclined to it at a positive angle is deflected upward to a considerable degree some distance in advance of the surface; which result has more recently been confirmed by injecting thin lines of smoke into wind tunnels.

Next he tells us that "there is of course a decrease in the absolute drift component of the air pressure, proportional to the decrease in the absolute lift." This statement can be true only for very small angles of incidence. If, for instance, the free rear edge of the fabric drops slightly, so that its angle of attack changes from, say, 20 degrees to 30 degrees, there will be a decrease in the absolute lift, but an *increase* in the absolute drift.

In reasoning by analogy from the sailing vessel, Mr. Linton says that the sail *automatically* varies to the most favorable form under any conditions of wind pressure and direction of wind pressure. This statement is not true. Any yachtsman knows that a sail ought to be brought to a relatively shallow curvature for reaching, and allowed to bag somewhat for running. The late A. Cary Smith, by means of a contrivance called the reach reef, which enabled the curvature of a sail to be varied manually at will, succeeded in substantially increasing the speed of a number of racing yachts. Mr. Linton also does not seem to be aware that sails are not efficiently operative at angles of incidence as low as 5 degrees, which is about the maximum now found in efficient aeroplanes. I confess I do not understand just what he means when he says that "in both classes of vehicles the best efficiency could only be obtained by altering the length of the chord." Possibly he is thinking of variable *area*, a device that offers many theoretical advantages. However, Eiffel has demonstrated that about the best length for the chord of an aeroplane wing is one sixth of its span, and no noticeable gain in efficiency can be had by varying greatly from this proportion.

Mr. Linton is again gravely wrong when he asserts that "full speed when once attained is as regular as that of the highest types of automatic machinery." The best aeroplane will undulate slightly in its flight path, requiring an occasional touch of the elevator to keep it horizontal, just as a ship, and, for that matter, an automobile, requires an occasional touch of the wheel to hold it to a straight course. The resulting constant changes in the angle of incidence of course cause a constantly varying drift, and consequently an uneven speed. The magnitude of this speed variation will probably surprise Mr. Linton very much if he will consult the reports of the speed tests made on a Zodiac biplane at the Aeronautical Institute of St. Cyr, an abstract of which he will find in *Aero and Hydro*, vol. v, page 25. The gentleman does not seem to know that the ability to vary the speed of horizontal flight within wide limits is a most desirable quality of the aeroplane. The Cody biplane's ability to vary its speed of level flight between 48.5 and 72.4 miles per hour, a range of 49.4 per cent, contributed largely to its winning of the British military trials.

The belief in the parabola as the only correct basic curve for wing sections, a belief which Mr. Linton asserts with much positiveness, belongs to the ancient days when we knew absolutely nothing of the actual conditions around an aeroplane wing in flight. The belief might be correct if we were dealing only with the principles of dynamics; as a matter of fact, we have to deal also with the properties of a gas, and recent discoveries seem to indicate that effect due to the latter is the more important. No successful aeroplane in use to-day employs a wing of purely parabolic curvature. Practically all employ compound and irregular curves, or combinations of curves and planes, the design being wholly empirical, and with such wings they manage to fly fairly well, and to return in useful work a very large proportion of the energy expended. Moreover, as Eiffel's tests definitely prove, the wings in actual use which are based on the circular arc give, on the average, better results than those approaching the parabolic form. But it is as silly to expect any definite and universally correct curve for a wing section to be discovered as it is to expect that any curve can be always the correct one for the waterline section of a ship's hull.

Personally, I have often observed a piece of fabric suspended by one edge in a current of air, and I never saw one piece rise to a sufficiently acute angle of incidence for aeroplane use without beginning to flap or undulate. This effect is in part due to the fact, first demonstrated by Montgomery, that the air flowing around the curve tends to assume a rotary or eddying motion, strong enough to deform the fabric, and in part due, I believe, to the fact that the fabric is, by its structure, uniformly loaded. In proposing to uniformly load his full-sized piece of fabric by means of metal bars uniformly distributed over the top surface, Mr. Linton is most obviously ignorant of the fact that Eiffel has tested rigid curves of practically every form that the fabric might assume, and in no case has the slightest approach to a uniform distribution of pressure been discovered. To, as he suggests, adjust the angle of incidence, and, incidentally, to make the fabric keep still long enough to be photographed, by shifting the weight of the metal bars, would involve an infinite number of trials, thus reducing his plan to the "cut-and-try" process which he so scorns in the first paragraph of his letter. Eiffel has proved, although Mr. Linton is not aware of it, that from 65 per cent to 90 per cent of the total lift is due to the reaction of the air on the *top* surface of the wing. How will the irregular ridges of metal bars on top of the fabric affect this reaction? And, since an actual rigid wing must have several inches of thickness, how will Mr. Linton determine the correct curvature of the upper surface? If he makes the upper surface parallel to the predetermined lower, will he join the two in a sharp or a round edge? Does he know that two wing sections, in all respects identical save that one has a sharp entering edge and the other a well rounded entering edge, will give very different values of *Ky* and *Kx-Ky*, and different locations of the center of pressure?

As a matter of fact, if Mr. Linton were superficially informed on actual aeroplane development, he would know that his idea of flexible fabric wings has already been cut and tried. The Vlaieu monoplane employs wings of flexible fabric, entirely unsupported by ribs of any sort, and perfectly free to assume any curve impressed on it by conditions of speed and load. At the last international meet at Vienna, June 23rd to 30th, 1912, a machine of this type, equipped with a 50 horse-power Gnome motor, and piloted by its designer, flew very well, and won several minor prizes. But, in spite of the fact that it was lighter than the average one-place monoplane, the best speed it could make was 43.75 miles per hour. Inasmuch as there are a great many other monoplanes, equipped with this same motor, of the same horse-power, of generally heavier construction, and using rigid, empirically-designed wings, that are easily capable of speeds from 50 per cent to 90 per cent greater, no further comment on the enormous drift and inefficiency of non-rigid wing surfaces is necessary. JOHN G. HANNA.

Galveston, Texas.

A Monster Hydro-aeroplane

MENTION was made last week in our article on "The Big Aeroplane and the Transatlantic Flight" of a new double biplane that was intended to make its *début* at the Monaco meet.

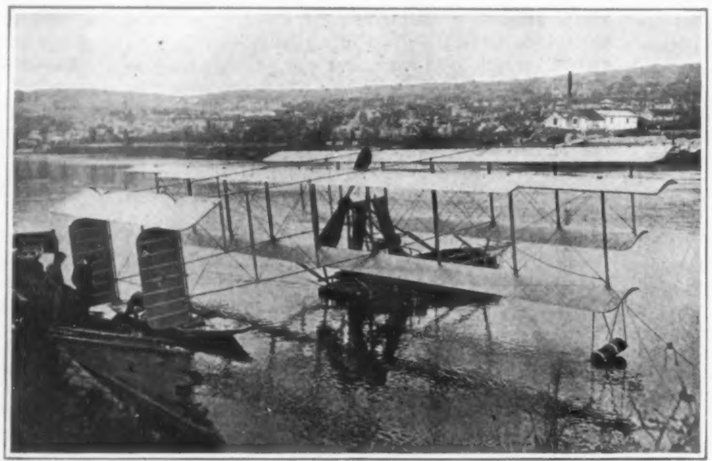
A good idea of this huge machine is to be had from the photographs which we have reproduced on this page. These show two biplanes, one behind the other, mounted by means of forwardly inclined struts upon a 22-foot hydroplane hull. A large, rectangular, movable surface forms the elevator and is mounted directly above twin vertical rudders at the rear end of a tubular framing which extends from front to rear of the entire machine. There is no tail surface, the following planes alone being depended upon for the longitudinal stability. The spread of the second, or main, set of planes is 24 meters (78.6 feet), while that of the front set is probably 15 to 18 feet less. Both sets of planes are narrow from front to rear, the chord being not over 5 feet. This is noticeable in the side view of the machine. Ailerons will be fitted to the upper rear plane for transverse stability. Cylindrical steadling floats are fitted beneath each end of the main biplane, as can also be seen in the side view. This picture, furthermore, discloses the top of one of the two 230 horse-power Chenu 6-cylinder motors, which are placed side by side, and which drive the single, 2-bladed 14 feet 5-inch propeller in front of the main biplane by means of chains. The inclined radiators extending from the propeller shaft down to the boat can be plainly seen in both illustrations.

This huge water-plane was built by the aviator, Colliex, for M. Jeansson. Its length over all is 16 meters (53 feet 6 inches), and its weight complete 4,300 kilogrammes (9,460 pounds). It was not completed in time for the meet, but is now about ready for test. The result of its trial flights will be awaited with eagerness by all interested in the transatlantic flight, for it is some such huge aeroplane that will, in our opinion, eventually make the 1,800-mile trip without a stop. Already about a score of men of different nationalities are engaged in designing machines for this great undertaking. A prize of $50,000 has been offered.

How to Make Dwarf Trees

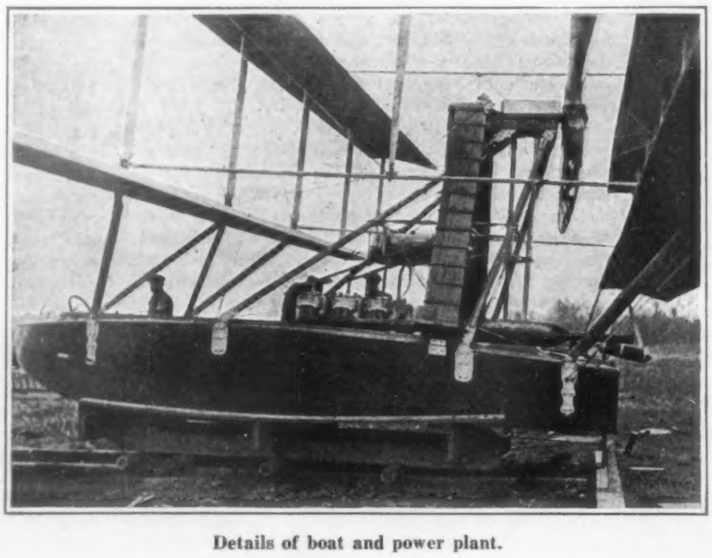
HOW gardeners manage to grow miniature pines, firs, and oaks in flower-pots for half a century has always been more or less of a secret. It is the result chiefly of skillful, long-continued, root-pruning. They aim first and last at the seat of vigorous growth, endeavoring to weaken it just as far as possible without destroying the life of the tree. They begin with the young plant, say a seedling of a cedar or hemlock, when only two or three inches high, and cut off its tap-roots as soon as it has other rootlets enough to live upon, and replant it in a shallow earthen pot or pan.

The end of the tap-root is generally made to rest on the bottom of the pan, or on a flat stone within it. Alluvial clay is then put into the pot, much of it in bits the size of beans, and just enough in kind and quantity to furnish a scanty nourishment to the plant. Just enough of water, light and heat is given to keep it alive, but not enough to excite a vigorous habit. Gardeners usually pride themselves on the shape of their miniature trees, and they use strings, wires, and pegs, and various other mechanical devices, to promote symmetry of habit, or to fashion their pets into odd fancy figures. Thus, by using very shallow pots, the development of the tap-roots is impossible, and by using poor soil and little of it, and little water, rapid growth is prevented. Then, too, the top and side roots, which are within easy reach of the gardener, are shortened by means of a pruning knife, or are seared with a hot iron. In this manner the little tree is headed off on every side and is allowed to grow just enough to live and look healthy. Accordingly, each new set of leaves becomes more and more stunted, the buds and rootlets are diminished in proportion, and at length a balance is established between every part of the tree, making it a dwarf in all respects. In some species this end is reached in three or four years, while in others ten or fifteen years are required.



Three quarter rear view of Jeansson double biplane, showing elevator and twin vertical rudders in foreground.

Side view of biplane, showing method of attaching to boat as well as float below end of main plane.



Details of boat and power plant.

A GIGANTIC AEROPLANE

Some Recent Views from the Panama Canal

THE people of the United States, and of the whole world, for that matter, are greatly indebted to the camera for the good work it has done in keeping them in touch with the progress of work on that great undertaking. Such views as those which are herewith presented afford an excellent impression of the magnitude, stability and high character of the construction. Now that the great work is practically completed, the photographs become highly instructive.

Of the views presented herewith, the most interesting will be that showing Gatun Lake, which during the past year has been spreading far and wide over the valley of the Chagres River. The formation of this great inland sea—for it is nothing less—is the key to the whole Panama problem. By its formation, the turbulent Chagres River, which in the earliest days of the work caused the engineers so much anxiety, particularly during the French and the earlier American control of the work, has been brought into subjection and made to serve a great and useful purpose. The impounding of the waters of the river by the dam at Gatun has not only eliminated a large amount of otherwise necessary excavation, but it has afforded some twenty miles of deep water navigation, and in the stretch of the lake which is shown in the view above referred to, it will be possible for steamers, if they so wish, to proceed for several miles after they have passed through Gatun locks at full speed. The view is taken from the southerly end of the locks, looking south over the central guide wall which forms a continuation of the middle wall that lies between the two adjoining sets of locks. On either side are seen the tracks for the towing locomotives, with a central track for the return of the same after they have taken a ship out, or as they proceed to the end of the wall to take a ship in tow.

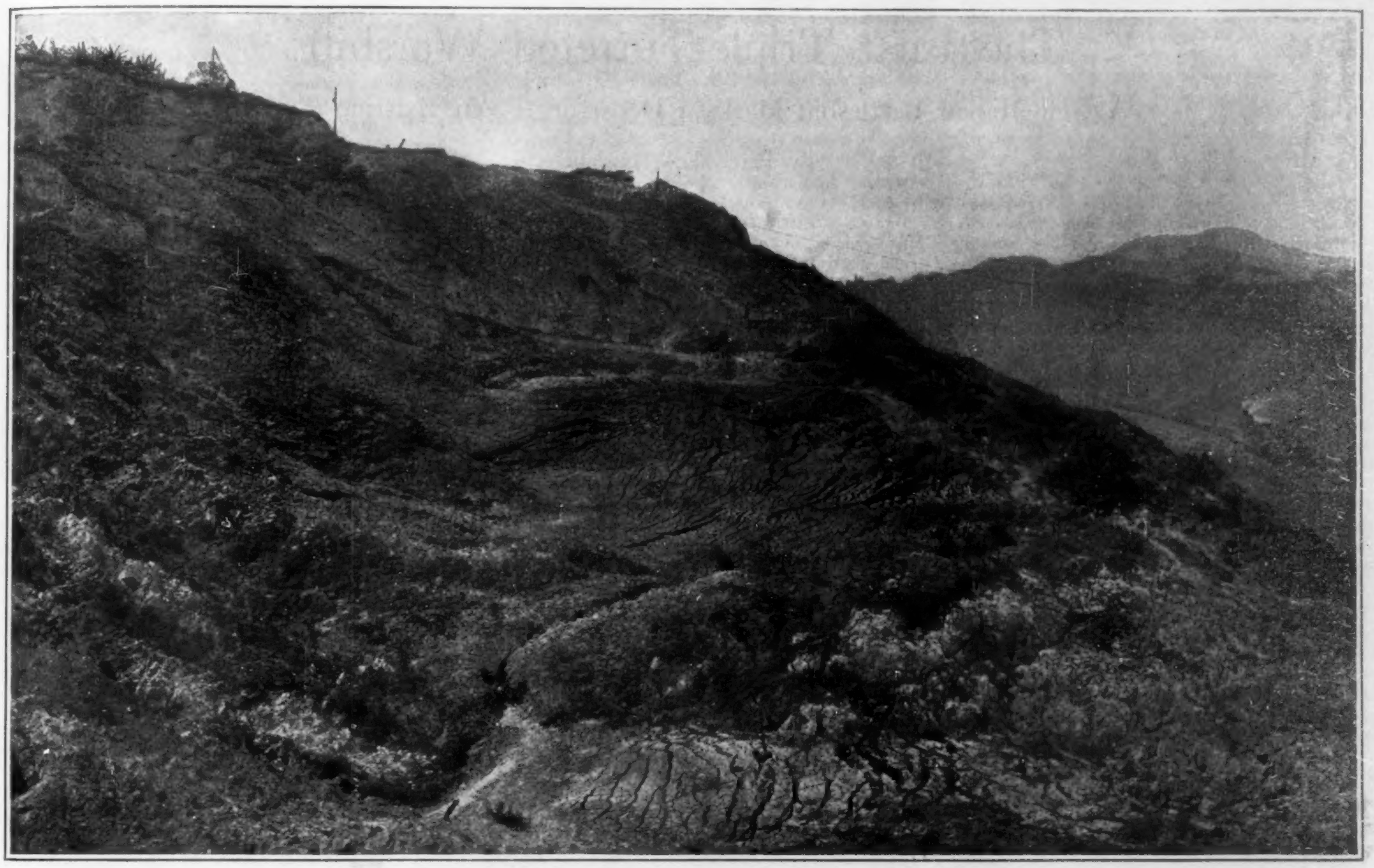
The massive, bridge-like structure shown in another view is the upper portion of what is known as the emergency dam. This is nothing more nor less than a counterweighted swing bridge, similar to those which span the main channel when railroad bridges are carried across a navigable river. Should an accident occur to the locks, such as might be occasioned by a ship colliding with and breaking down the gates, this swing bridge would be turned until it spanned the entrance to the locks. Then a series of heavy, vertical girders would be lowered, until they extended from the bridge down to footings at the bottom of the entrance, and upon these girders large square steel plate slabs would be lowered, tier above tier, until the whole channel was closed and passage of the water out of the lake prevented.

Very impressive and instructive is the view of the upper guard gates of the easterly side of locks at Gatun. The structure as shown is complete, with the footbridge for crossing the gates in place. At the top of the gates at each end, and immediately below the footbridge, will be seen the two massive steel arms, each five tons in weight, by which the gates are swung open or shut. The arms pass beneath the surface of the side wall of the locks to connect with a large gear wheel, electrically operated, the gear being so powerful and well proportioned that the gates are handled with ease and great accuracy of control. The gates are seven feet in thickness and are hollow and watertight in their lower portions. They are made hollow to give them buoyancy, so that the greater part of their weight, which in each leaf runs from four hundred to six hundred tons, will be waterborne. The square holes which are noted about mid-height of the gates, as seen above water, enable the water to pass within the upper portion of the gates, and prevent them from a tendency to rise when the water is at the eighty-seven foot level.

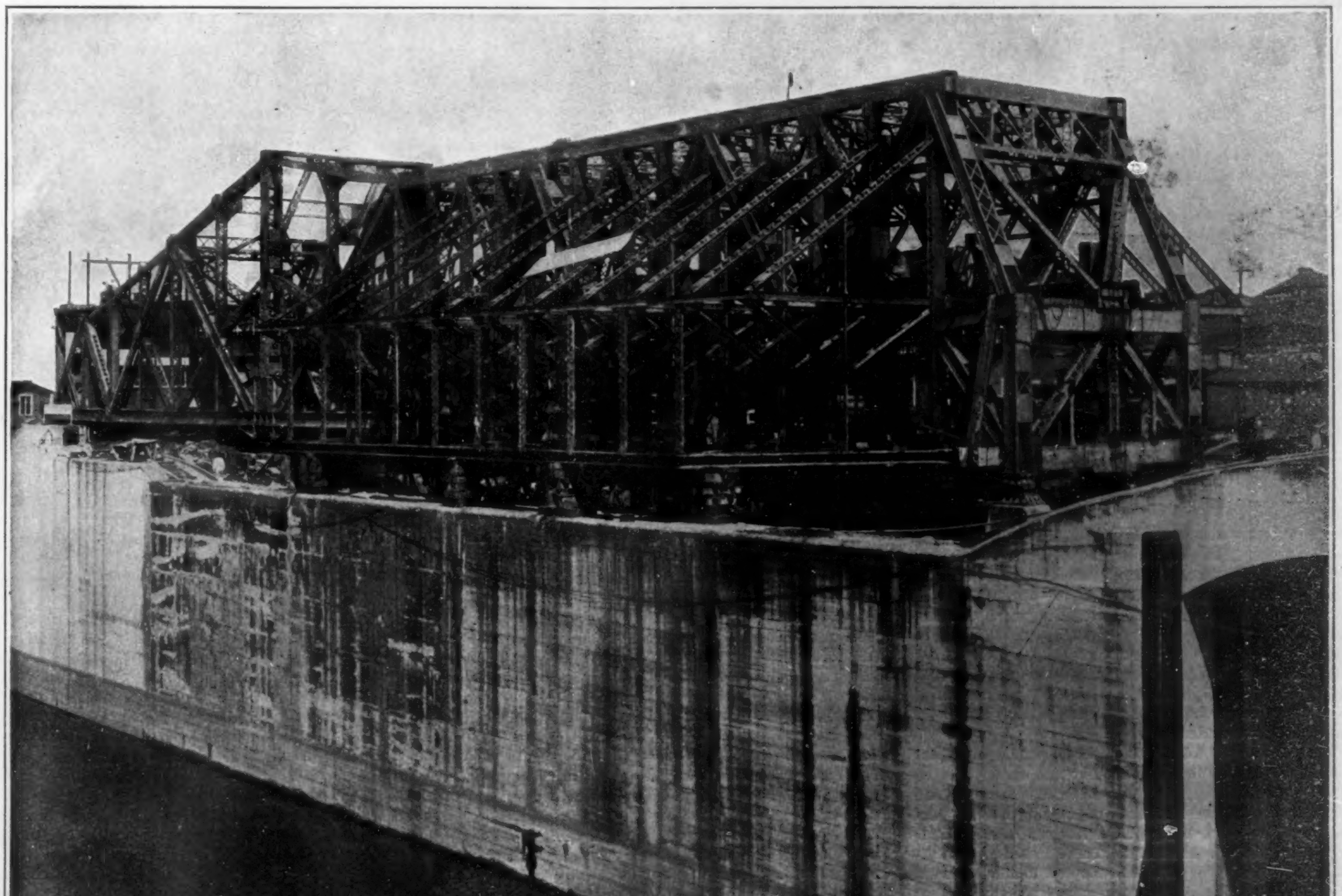
The photograph of the big slide at Culebra explains very clearly why it is that the lofty sides of the cut at this place refuse to stand at the original slope the engineers intended. It will be understood that as the bottom of the side of the cut is crushed under the great load overhead, the material breaks up, losing its consistency, and becomes practically a mass of muck with very little consistency. Troublesome and costly as these slides are proving, Col. Goethals has stated that they will not delay the opening of the canal—so great is the capacity of the excavating machinery, which, as the big cut is being cleaned up, will be concentrated in full force at this particular location.

Ski-making in Norway

THIS is the latest out-of-the-way industry to be described in the versatile American consular reports. The consul general at Christiania states that Norwegian skis are not made in factories, but by carpenters who devote all their time to this pursuit, in summer laying up a supply for the following winter. They make them in their homes, by hand, and sell direct to the users or to retail stores. Lately Germany has begun to make skis by machinery. The best skis are made of green ash, the next best of oak, and the cheaper grades of fir and pine. They vary in length, the rule being that skis should be as long as the distance from the ground to the height the wearer can reach with extended arm and finger tips. The "bindings" for skis are made by local harness makers and sporting goods factories, and are of pigskin. Skiing poles are made of ash, oak, or bamboo. Near the point a ring of wood encircles the pole, to which it is attached by leather strings; this is to keep the pole from sinking more than a few inches into the snow.



A characteristic view of the Culebra slide. This view shows the unstable muck-like nature of the material.



Photographs by Underwood and Underwood.

Erecting emergency dam. In case of gate failure this massive turntable bridge will be swung across the entrance, and gates will be lowered, cutting off the water.

SOME RECENT VIEWS FROM THE PANAMA CANAL.

The First Triple-Turreted Warship

A New Italian Battleship Marks a Departure From Existing Types

By Percival A. Hislam

THE triple-turret warship is now an accomplished fact. The Italian battleship, "Dante Alighieri," and the Austrian battleship, "Viribus Unitis," both equipped on this system, have successfully completed their trials. In both cases it is reported that the three-gun turret gave every satisfaction, as regards both the mountings and the rapidity of fire. A long-discussed question is thus definitely answered.

The distinction of being the first warship with three guns in a turret to pass into commission belongs to the Italian vessel. The "Dante Alighieri" was laid down at Castellamare on June 6th, 1909, launched on August 20th, 1910—she was the first all-big-gun ship to be launched by a Mediterranean power—and was commissioned in the middle of August. She is 520 feet long on the water-line and 87½ feet in beam, her lines being, therefore, considerably finer than those of the majority of modern battleships. This is largely due to the fact that Italy is more or less combining guns (14-inch) arranged on the principle of the "Viribus Unitis," save that the superposed turrets will contain two guns instead of three, giving an end-on fire of five, and a broadside fire of ten. In the "Pennsylvania" there will be three 14-inch guns in each of the four turrets.

The protection of the Italian ship shows plainly in what direction sacrifices have been made to secure high speed and a powerful armament on a small displacement. The main belt is only 9⅞ inches thick, and even this thickness is not maintained over the whole length of the citadel. The main belt is roughly terminated at the outside funnels, and the bases of the end turrets are protected by only 7 inches of armor. The barbettes, or gun-bases, are protected by only 9 inches of armor, and the hoods over the guns are half an inch thicker. Here again it is interesting to recall the case of the "Nevadas," which have a uniform belt of 13½ inches inclosing the whole of the vital parts, while bined broadside of forty 12-inch guns, while the first four Italian ships will total fifty-one.

Wrongly Named Substances

BLACK lead does not contain a single particle of black lead, being composed of **graphite**.

Brazilian grass does not come from Brazil, or even grow there; nor is it grass at all. It is manufactured from strips of palm leaf (*Chamærops argentea*) and is imported chiefly from Cuba.

Burgundy pitch is not pitch, nor is it manufactured in, or imported from Burgundy. The best is a resinous substance prepared from common frankincense and brought from Hamburg; but by far the greater quantity is a mixture of palm oil and resin.

Cuttle bone is not bone, but a structure of pure chalk, once embodied loosely in all the substance of certain extinct species of cuttlefish. It is inclosed in a membranous sac, with the body of the fish, and drops out when the sac is opened, but it has no connection whatever with the sac of the cuttlefish.

Galvanized iron is not galvanized. It is simply coated with zinc; and this is done by dipping it in a zinc bath containing muriatic acid.

German silver is not silver, but a metallic alloy, which was not even invented by a German. It has been used in China for ages.

Honey soap contains no honey, but is one part palm-oil soap and three parts yellow or crude soap, scented.

Japan lacquer contains no lac and is made from a kind of nut tree.

Meerschaum is a composition of silica, magnesia and water. The name implies petrified sea foam.

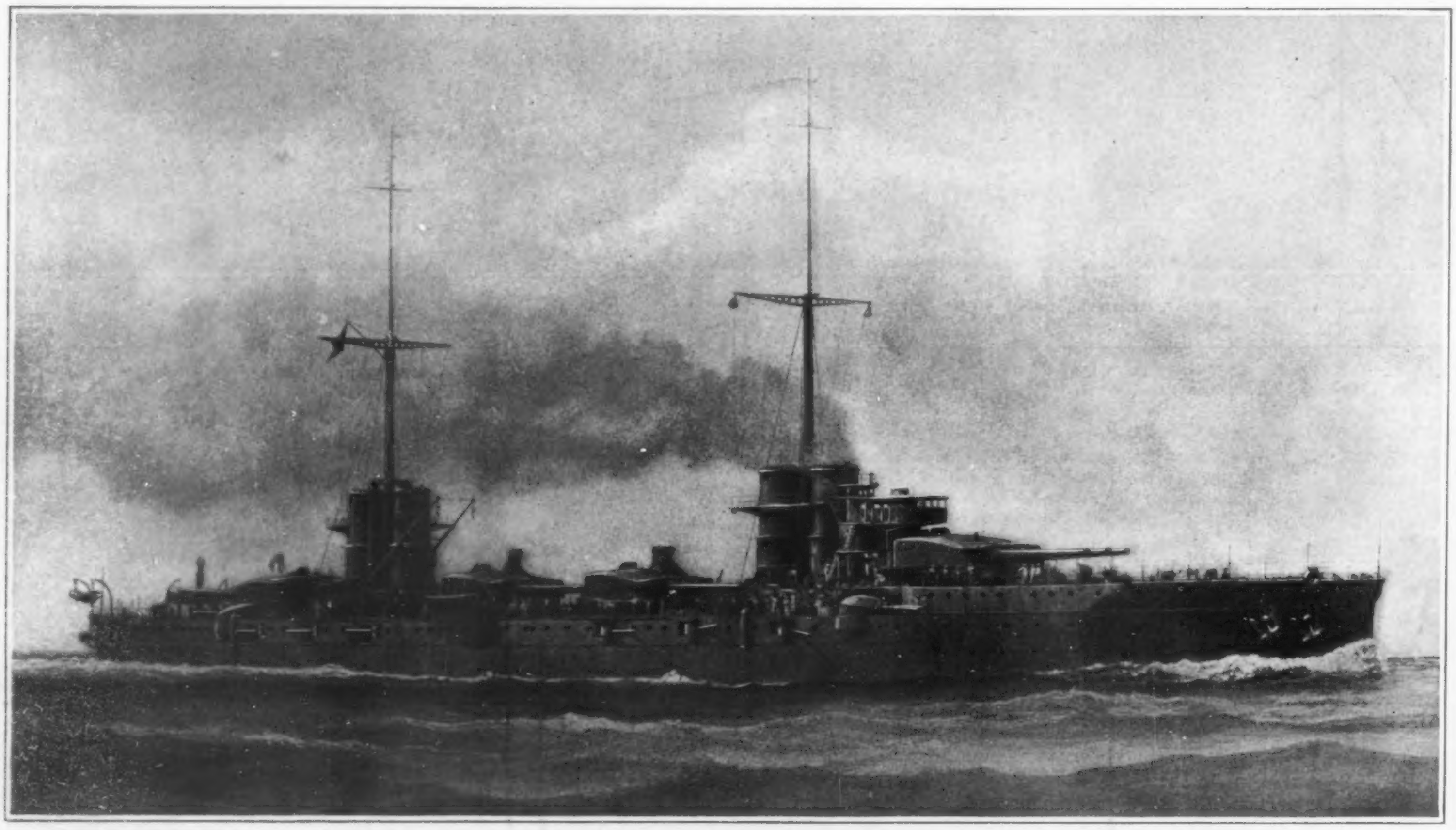
Mosaic gold has no connection with Moses or the metallic gold. It is an alloy of copper and zinc, used in the ancient musivum or tesselated work.

Mother of pearl is the inner of several sorts of shells, but not the real mother of pearl, rather being the matrix of pearl.

Pen means a feather (Latin *penna*). A steel pen then is a misnomer.

Salad oil is not oil for salad, but for cleaning salades.

Whalebone does not possess any of the properties of bone, but is a substance attached to the upper jaw of the whale and serves to strain the water which the creature takes up in large mouthfuls.



Displacement: 19,400 tons. **Speed:** 24 knots. **Armor:** Belt, 9⅞ inches; turrets, 9½ inches. **Armament:** Twelve 12-inch guns, twenty 4.7-inch guns. **Coal Supply,** 2,500 tons.

Italian battleship "Dante Alighieri."

the battleship and the battle-cruiser in her newest ships. Indeed, no distinction is officially drawn between the two principal classes of armored vessels in the Italian fleet, ships of both types—battleships and cruisers—being known collectively as "nave da battaglia."

As a result, speeds are unusually high. Italian designers have for many years past produced fast and heavily armed vessels on comparatively small displacements, but only at the expense of armor, and also, it is believed, of structural strength.

The "Dante Alighieri" has a displacement of 19,400 tons, and for her main armament she carries twelve 12-inch 46-caliber guns in four center-line turrets. The arrangement of the turrets is rather unusual in four-turreted ships, one being placed fore and one aft, and two close together amidships. The disposition may fittingly be compared with that adopted in the Austrian "Viribus Unitis," which has two superposed turrets fore and aft, and with that of the Russian battleships of the "Gangut" class, in which the two interior turrets are arranged on the *echelon* principle. In the last two cases there is a full broadside and an end-on fire of six guns, while the Italian vessel, though firing twelve guns on the beam, brings only three to bear ahead and astern.

It may be recalled that the United States battleships "Nevada" and "Oklahoma" will have their big the guns are protected by 13-inch bases and 16 to 18-inch turret faces. The "Dante Alighieri" has one protective deck an inch and a half thick; the American ships have two, one of 3 inches and one of 1½ to 2 inches.

The designed speed of the Italian ship was 23 knots, with turbines of 26,000 horse-power. On her trials she is reported to have made 24 knots with something in hand. Her armament against torpedo-craft comprises twenty 4.7-inch guns, twelve mounted behind 4-inch armor on the main deck and eight in small turrets abreast of the big-gun turrets at either end. Three submerged torpedo-tubes are fitted; the maximum coal capacity is 2,500 tons, and the complement is 900 officers and men.

Three other and larger Italian dreadnoughts are completing afloat—the "Conte di Cavour," "Leonardo da Vinci," and "Giulio Cesare." On a displacement of 22,340 tons these ships will carry thirteen 12-inch guns in five center-line turrets. The first, third and fifth will have three guns in each, while the second and fourth will be superposed over the first and fifth, and will contain two guns each. Two similar ships, "Duilio" and "Andrea Doria," are building, and two more, to be armed with 14-inch or 15-inch guns, will shortly be laid down. It is interesting as bearing on the differences between contemporary dreadnoughts to notice that the first four French ships of this type will have a com-

Safety-match Cough Lozenges

By John Phin

CHLORATE of potash is a favorite ingredient in "cough" lozenges, and when made up with a little sugar it forms a very palatable and effective confection. But it is not generally known that one of these lozenges if rubbed on the igniting surface of a safety-match box will take fire and burn. Most of the lozenges sold by druggists, however, contain too little sugar to work well, and some are composed of pure chlorate and will not work at all. But it is easy to make a lozenge or tablet that will give startling results.

Take two ounces of chlorate of potash and one ounce of white sugar and grind them *separately* to a very fine powder. If you attempt to grind them after they are mixed, you may get into trouble. Mix the two dry powders thoroughly and moisten them with a little water or syrup so that they may be worked into a stiff dough. Sprinkle some dry and finely powdered chlorate on a smooth board, so as to prevent the dough from sticking to it, and roll the dough into a thin cake, about the thickness of an ordinary lozenge. This cake may then be cut into tablets with a knife or into round lozenges by means of a cutter. A tin tube, with the edge filed sharp, answers well. I use a gun-punch. Dry the lozenges thoroughly; this is essential and takes time, as the drying must be done at a moderate temperature; if placed in an ordinary oven, they may take fire.

One of these lozenges rubbed against the active surface of a safety-match box will take fire and burn furiously, to the great surprise of those who perhaps at the very time are dissolving one of them in the mouth. But be careful not to hold the lozenge in your bare fingers when you rub it or you may get a very severe burn. It may be grasped between the folds of a piece of stiff card-board, but a better plan is to take a small wooden board, 4 by 2 inches, and in it, with a center-bit, bore a hole to a depth a little more than half the thickness of the lozenge, so that when the latter is placed in the hole it will rise a little above the surface of the board; or the lozenge, while rubbed, may be held in place by four tacks or small nails driven into the board so far that they will stick up just about half the thickness of the lozenge.

Having placed the lozenge in the hole or between the tacks, rub it with the safety-match igniting surface, and it will immediately burst into flame. It may be used to light a cigar, lamp or candle.

There is no danger in this experiment if ordinary care be used. I have exhibited it many times in parlors and dining rooms, and it always excites great surprise. But like all other experiments of the kind it should be well tried in some out-of-the-way place before an attempt is made to exhibit it even to a private audience.

Dry Batteries and How to Make Them

By Omega

TO construct a good working, semi-dry cell, procure some pieces of ordinary sheet roofing zinc, six inches wide and seven inches long, bend them around a piece of iron gas pipe, to form a cell six inches high. Cut a circular piece of zinc so as to fit one end, and this will form the bottom of the cell, which must be fitted and soldered after the lapped joint has been soldered.

If desired the cell may be made square, in which case a block of wood planed smooth all over, with the corners slightly rounded, may be used. The block should be made $2\frac{1}{4}$ inches square, so that the sheet of zinc must be cut 6 by $9\frac{1}{2}$ inches. This size will give about $\frac{3}{8}$ of an inch lap. The bending will take up about $\frac{1}{8}$ inch. When the joint has been soldered, and the bottom inserted and soldered, a brass terminal or a piece of insulated copper wire must be soldered to the top of the zinc. The length of the soldered joint and the soldered part around the bottom must be brushed over the inside with asphaltum varnish, and dried.

Procure the number of carbon rods or plates that may be required, say three or four, with a brass terminal attached. These rods or plates can be obtained at almost any electrical supply store, with their tops, to which the binding screw is attached, already steeped in paraffin. The object of this paraffin treatment is to prevent the creeping of the saline solution, thus preventing the corrosion of the brass binding screw.

Prepare the following mixture: Pebble or crushed carbon and carbon dust, $3\frac{1}{2}$ pounds; whitewood or willow sawdust, $\frac{1}{2}$ pound; black oxide of manganese, $1\frac{1}{2}$ pounds; granulated chloride of ammonium, $1\frac{1}{2}$ pounds.

From a piece of stout blotting paper cut circular or square pieces to fit the bottom of the cells, also pieces to form linings for the inside, so as completely to cover the zinc element. Previous to inserting these, make up a solution of either nitrate of mercury or bichloride of mercury, in either case one ounce of the salt to one quart of *hot* water. If the bichloride of mercury is used, add one ounce of chloride of ammonium (sal ammoniac). The addition of this salt will aid considerably the dissolving of the bichloride. As soon as this solution has become cold, fill one of the zinc cells to the top with a portion; in the course of a few seconds the inside of the cell will become covered with a thin gray coating of mercury. Only a few seconds time is necessary for this operation. Treat all the cells alike by pouring the liquid from one cell to another, and when the operation is completed, the spare liquid may be returned to the stock solution and kept for future use. Drain each cell; then insert the blotting paper linings, pour a small quantity of the carbon manganese mixture into one cell, place on this a carbon rod, pack in more of this mixture, and press it down with a piece of wood. As soon as the cell is one third full, pour upon this a mixture of sal ammoniac, 4 ounces, dissolved in a quart of water. As soon as the liquid has become absorbed continue to fill the cell with the carbon mixture until two thirds full. Pour into this some more of the sal ammoniac solution and fill the cell with the carbon mixture until within half an inch of the top. Cut a piece of cardboard to fit the top of the cell, with a hole in the center so as to pass over the carbon rod, and soak this cardboard in hot paraffin previous to fitting it in place. Fit all the cells in like manner, and pour some melted pitch from a disused small saucepan, or iron ladle, upon the top of the cardboard; then pierce the pitch and cardboard with the pointed end of a metal meat skewer made red hot, or a piece of iron rod $\frac{1}{8}$ inch in diameter, so as to form a vent. The cell may now be brushed all over with asphaltum varnish, and when this coating is dry each cell should be covered with a single wrapping of stout brown paper and a covering of the same material for the bottoms also.

The object of the sawdust is to retain and hold in suspension the saline exciting liquid, while the covering of the joints inside with asphaltum varnish prevents the mercury solution from attacking the soldered joints. The amalgamating of the zinc surface with mercury augments the electromotive force of the cell, and insures a longer life. Plain zinc may be used, but it is not so effectual as when amalgamated. The black oxide of manganese acts as a depolarizer. Carbon plates or rods that have been used in exhausted dry cells can be used in making up more cells, because the quality of the carbon has not deteriorated, while being already provided with a connecting screw, a little cost in making up the new cells would be saved.

Hints for Young Microscopists

By Norman Barden

WE do not look through the microscope just to see an object enlarged, but more often to see the structure of that object with its details. Sometimes it is the details of some pathological specimen, of some insect or possibly of one of the infusoria. Each of the specimens named would require a different mode of preparation to obtain the best results, but there is a general plan of operation that is possible, and it is to be described. It is true that coarse and large specimens may be placed under the microscope on the end of a needle or held with the forceps, but ordinarily there must be some degree of preparation to show the interior structure. Moist tissues of insects will have to be preserved in some preservative after they have been desiccated. The mounting media used has a great deal to do with the appearance of the specimen under the microscope. If the refracting power of the mounting media is the same as that of the specimen, the object cannot be seen at all. Hence, we must guard against using the same media for mounting everything, as we shall see later.

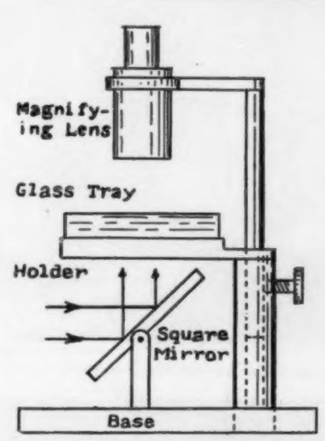


Fig. 1.—Arrangement of the dissecting apparatus.

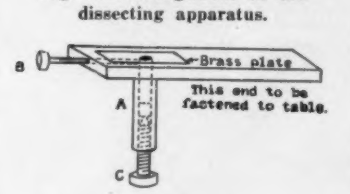


Fig. 2.—Simple form of microtome.

Generally speaking, there are two methods of preparing objects for microscopic investigation: 1. Mechanically, by picking and teasing, for the separation of cells and isolation of elementary parts. 2. Chemically, by the use of reagents to dissolve fats, loosen connective tissue, and to act differently on different elements.

There is a host of instruments manufactured for dissecting, but by practice the same can be accomplished with a few simple instruments. This does not apply to the cutting of sections, which, as everyone knows, is done best with the microtome. However, about four scalpels, two forceps, one sharp pointed and the other blunt, and a pair of small scissors are to be included in every complete set of microscopic accessories. The dissecting needles are the most serviceable of all the instruments and can be made by mounting long, fine needles in wooden handles. Some are to be left sharp pointed while others should be given a cutting edge of about an eighth of an inch. Among the other instruments for dissecting, there should be a glass pan or tray about four by five inches, a good strong magnifying glass and a stand for holding it and the glass tray. A convenient way of arranging the apparatus is shown in Fig. 1.

To prepare the specimen by teasing, place a very small piece of it in water and pick it to pieces with the sharp pointed needles. This is easily accomplished if the specimen has been macerated for a few days in some chemical such as potassium hydroxide to dissolve the fats and loosen the connective tissues. The teasing must be performed slowly and accurately. Beginners fail a great many times because they give up too soon or they sit in a strained position which causes them to become nervous and consequently their arms

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Plate 1.—Implantation of hair.

Plate 2.—Section of tongue.

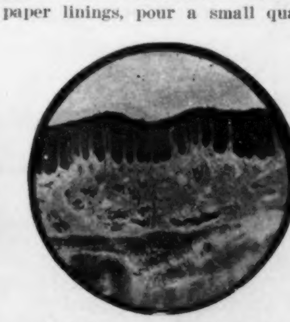


Plate 3.—Bare papillae of the tongue.

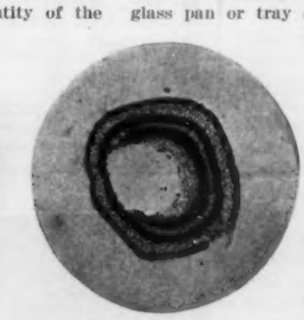


Plate 4.—Section of a vine stem.

Plate 5.—Maxillary palpi of tongue of house fly.

Inventions New and Interesting

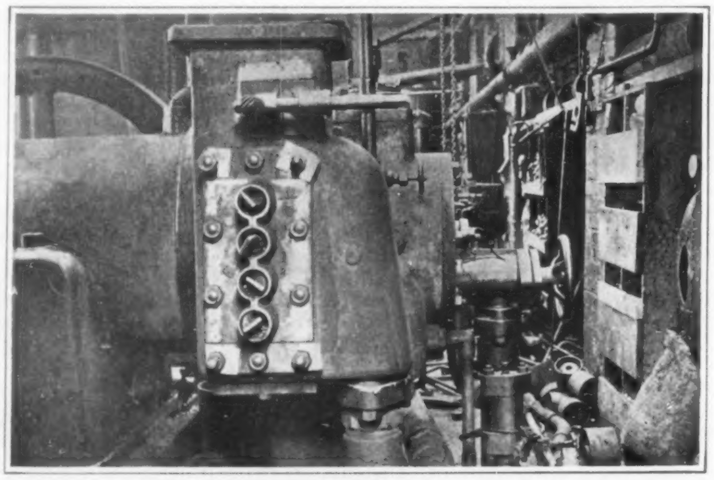
Simple Patent Law ; Patent Office News ; Notes on Trademarks

A Coal Engine

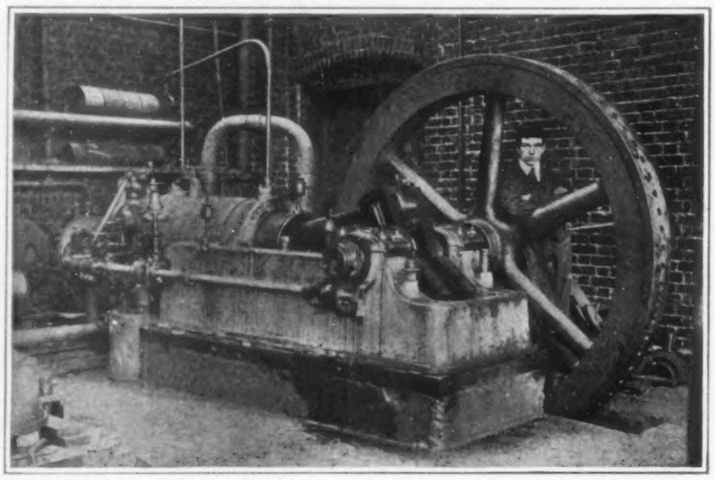
By the Paris Correspondent of the Scientific American

THE internal combustion engine invented by Mr. Archibald Low, a prominent English engineer, is attracting much attention among engineers owing to its novel method of working. In fact, it is operated by a direct feed of coal so as to contain the gas-producer in very compact shape directly within the engine itself and without increasing the size of the engine appreciably. The inventor has been working for a number of years upon the subject, and now brings out a practical running engine of 80 to 100 horse-power size, such as our engravings show. He first started with a small 2 horse-power engine in order to prove the principle of the direct coal feed, and after this had been run with good success he started building the large engine which is now running in London.

Our diagram illustrates the principal details of the engine, and it works in the following way. Tubes with worm conveyors running in them are used to take up the coal in size depending on the dimensions of the engine and to pass it along within the engine in order to subject the coal to heat within the tubes. In this way the set of tubes act as a gas-producer, and the gas then goes to the engine cylinder to be used on the internal combustion principle. On its way through the tubes the coal is first heated by the exhaust gases of the engine passing around the outside of the tubes, and this heat serves to drive off most of the coal gas, at least, where bituminous coal is used. The carbon and the tarry products then pass along the tube until they reach the part which runs through the combustion chamber of the engine cylinder where the combustion is taking place, and here they are still further heated and reach a high temperature. Steam and air are then injected through the tubes and upon the hot coal, and when this impinges on the heated carbon it produces water gas as well as air gas. Referring to the diagram, the coal is fed in through the hopper *A*, and the conveyors *CC* draw it along through the set of tubes, the worms being driven by suitable gears. The coal is first heated where the tubes pass through the chamber *E*, as here the exhaust gases of the engine play around the tubes. When in the combustion chamber of the engine *F*, the heating effect keeps up and the temperature is still higher. The gases from the coal are given off from the tubes by small openings which allow them to pass out into the collecting chamber *D*, and from here they pass to the inlet of the engine for use on the gas engine principle. In order to produce the combustible gas in the proper way, air and steam are admitted to the chamber *G*, which also serves as the ash box so that the suction strokes of the engine cause the air and steam to be drawn over the hot carbon, and this produces air gas and water gas. When using bituminous coal, which is a very good fuel for this work, the coal gas which the coal gives off in the first place, as we mentioned above, is added to the other gases, so that as soon as the coal gas is formed and the gas cock opened, a mixture of coal gas, water gas and air gas is drawn into the engine cylinder along with the needed supply of extra air. This forms the explosive mixture for the engine, and it is ignited and used on the ordinary internal combustion method. The present single cylinder is 16 inches by 25 inches. The engine is noticeable for its small size and compact build, and it is self-contained in spite of the fact that it produces its own gas from coal. Thus the new engine appears to be a remarkable one in many respects. The construction of the engine does not need any special care. Starting up is done in ten minutes with the first engine, and this time will no doubt be reduced. In starting, the engine is simply run on coal gas from the mains or by oil, and the change-over to the usual working is done by using a two-way cock at the proper time. No excessive wear is noticed upon the coal tubes, which is another good point. Of oil engines in this connection, especially the Diesel engine, the inventor remarks that however good the oil engine may be in itself, we should be sure that in the future extension in this field there will be a sufficient supply of oil fuel to be had. This point appears to have been overlooked, at least as far as England is concerned. Should the steam engine be put out of the field by its growing competitor, the oil engine, this becomes a leading question, and it is well known that the amount of oil in England produced from shale is comparatively small. In fact, the Admiralty admits that should the navy use oil exclusively for engines, the demand would be greater than the supply, and this regardless of expense, at least as far as government work is concerned. Should liquid fuel be used for only one thousandth part of the power production in that country, the home supplies would fall far short of what is needed. Without referring to importations of oil, and in time of war this might become impossible, it will be seen at any rate that the question is an important one for England as well as for many other countries. On the contrary, the new engine, should it become widely used, would employ coal which is so abundantly produced in that region. It is to be remarked that the engine is very economical to run, as the inventor states that it consumes only half a pound of coal per B. H. P. hour. The engine runs well even on slack which costs $1.25 a ton, which means that as to fuel it is about twelve times cheaper than oil.



Combustion head of engine from hopper side, showing gas tubes and conveyors.



A new internal combustion engine of 80 to 100 horse-power now in operation.

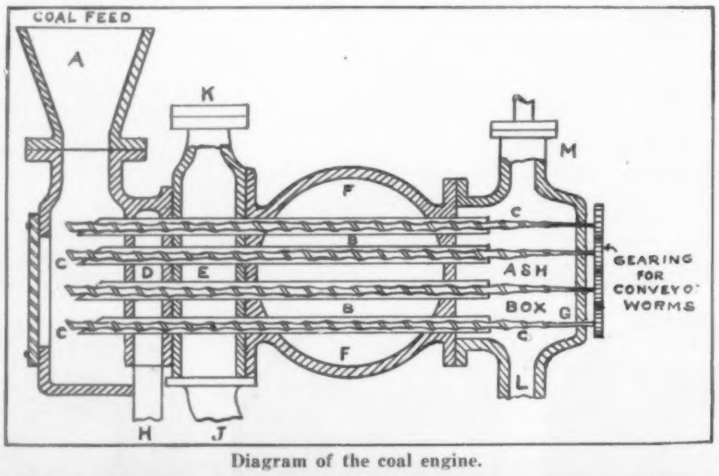
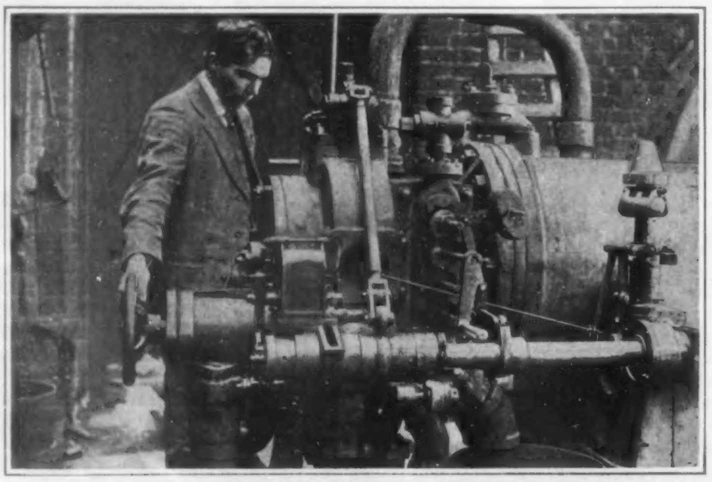


Diagram of the coal engine.



Low engine (with inventor). The engine is seen from the ash chute side.

The striking efficiency of the new engine is mainly due to the fact that it uses waste heat. Large gas engines are at a disadvantage, as the heat of the explosion cannot be absorbed as it should be by the piston which moves at a relatively slow rate. But in the new method the heat is utilized by increasing the surface of the combustion chamber, that is by inserting the producer tubes. Hardly any other change is needed beyond adding the compact parts for the gas production, so that the engine has much the usual appearance. The present engine runs at the standard rate of 140 revolutions per minute, and is found to give very satisfactory results as to the quality of the explosion, being of very easy running, and even more as used on coal gas. At the start, when changing over from coal gas to the normal run, the engine appears to run easier when using its own produced gas, owing no doubt to the quality of the mixture of gases which is employed. The engine can be run at a high temperature without fear of preignition, and the water in the jacket could even be boiled and the steam used without any damage. Space is saved by the absence of a producer and the engine need be no larger on this account, so that it appears to be well adapted for marine work.

Convention of the International Union for the Protection of Industrial Property

THE convention of the International Union for the Protection of Industrial Property, which was signed at Washing-

(Concluded on page 440.)

RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Pertaining to Apparel.

TIE HOLDER.—G. W. WILLIAMS, 198 De-Kalb Ave., Brooklyn, N. Y. This tie holder is adapted to be firmly held in position upon the inside of a collar, to hold a tie in place. The invention affords a free riding surface for a sliding tie in the wide portion between the standing and the turn-down element of a collar. The invention permits the tie to be readily drawn about in the wide portion between the elements of the collar, but at the same time will keep the tie away from the lower outer edge.

Electrical Devices.

TELEPHONE ATTACHMENT.—A. SCHLOSSER, Dodge, Neb. This invention relates to improvements in telephone attachments, and has particular reference to devices of this character devised for the purpose of detecting in a very simple and highly effective manner the interference with party lines due to unauthorized parties listening to a conversation.

ANNUNCIATOR SYSTEM.—H. CALDWELL, 501 Federal Bldg., Chicago, Ill. The more particular purpose here is to provide an electrically operated annunciator having a movable drum provided with characters which may be seen from a distance, the drum being so arranged that it may be quickly turned to any desired extent at the will of a distant operator.

Of Interest to Farmers.

BALE TIE.—E. A. FRANTZ, Weatherford, Tex. Address Frantz Standard Buckle Co., Weatherford, Tex. This buckle is for use in securing the ends of a bale tie such as used on cotton bales and the like, and the present invention relates to a construction including a swinging latch for closing the open end of the buckle. Mr. Frantz has invented another bale tie, the object of the improvement being to obviate in a simple and practical manner several former objectionable features by constructing the hook in such manner as to insure a positive engagement therewith of the side member when strain comes upon the band, and thereby produce an efficient and advantageous form of tie.

PLANT CANE SHAVER AND GRASS SCRAPER.—T. LAROSE, Labidieville, La. The intention here is to provide a mechanism having adjustable cutting devices and an adjustable deflecting device, the said devices being supported yieldingly by the main frame and capable of adjustment on the said main frame.

Of General Interest.

SEPTIC TANK.—G. R. PAYNE and S. MOORE, 823 Pine St., Texarkana, Tex. This invention refers to septic systems of sewage disposal, the aim being to provide improvements in the construction of the tank itself, whereby the system as a whole may be readily and quickly installed, and its capacity, either before or after installation, readily adjusted to suit existing conditions.

WAX EXTRACTING APPARATUS.—W. S. WATSON, Lock Box No. 1, Butler, Pa. The device is particularly applicable to extraction of wax from the candelilla plant. An object of the invention is to provide a device in which the process of extraction may be carried on continuously, the shrubs being placed in at one end and being taken out from the other, while the wax is taken out at a different place.

CLAMP.—I. L. BEVERAGE, A. C. SUDDARTH, and H. B. WOOD, Monterey, Va. Address A. C. Suddarth, Monterey, Va. The invention has for its object the provision of a device especially adapted for use in supporting woven wire fences, wherein means is provided for clamping the entire width of the fence with a uniform pressure.

COMBINED MATCH BOX AND BURNT MATCH RECEPTACLE.—A. C. HALL, 602 N. 31st St., Richmond, Va. Mr. Hall has devised a pocket receptacle for burnt matches which forms an attachment of a match-box proper. The receptacle is arranged directly

MATCH BOX AND BURNT MATCH RECEPTACLE.

under the match-box and provided with a metal fastening which engages the hollow body of the match-box and is fastened detachably at its free end by means of a spring catch. In other words, the latch fastening or latch detachably connects the match-box and receptacle and allows easy application and detachment of the former, and at the same time serves as a part of the fastening for the lid.

TETRODOTOXIN AND PROCESS OF EXTRACTING THE SAME.—Y. TAHARA, Tokyo, Japan, care of Takamine & Hitch, 552 W. 173rd St., New York, N. Y. The invention consists of chemical processes of extracting tetrodotoxin, the toxin of *Tetrotodon* (Jap. "*Fugu*"), and refuming thereof to its pure state after removing both organic and inorganic matters, together with various other impurities from the viscera of *Tetrodon* and the products obtained by the processes.

FOUNTAIN COMB.—L. H. DANCY, Holly Springs, Miss. This invention provides a comb for dyeing the hair or removing dandruff from the same, in which the container is removable from the comb and can be easily cleaned and in which the flow of liquid is controlled by pressure applied to the container, the liquid being distributed evenly to the surface of the teeth of the comb.

BOAT RELEASING DEVICE.—J. Y. PORTER, JR., Key West, Fla. The object in this case is to provide a device inexpensive to manufacture, and provided with a body which may be readily attached to the bow or stern of a life-boat without altering the construction of the life-boat or the arrangement of the air tanks thereon.

PORTABLE DITCH DAM.—A. CADWALLADER, Cliff, Neb. This invention is an improvement in portable ditch dams, and has for its object the provision of a simple, inexpensive, easily operated dam for use especially in irrigating ditches, for taking a specified amount of water from the ditch, regardless of the amount of water passing through the ditch.

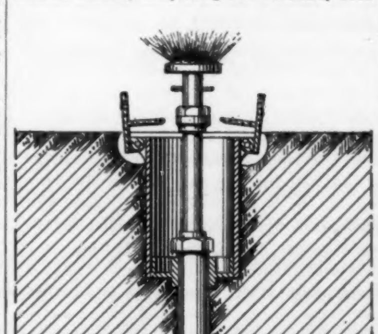
COMBINED SASH HOLDER AND SHADE SUPPORT.—J. NELSON, 400 Hemphill St., Hattiesburg, Miss. This invention provides sash-holding means, including elements adapted to be secured to the upper sash of a window and to move therewith, and elements attachable to parts of the window other than the upper sash, and relatively to which the elements carried on the upper sash are movable, whereby the upper sash may be lowered to any extent and sustained in lowered position.

CORE PLATE FOR LEVEES.—G. D. LUCE, Hagen Ave. and St. Peter St., New Orleans, La. This invention pertains to means for damming or controlling the flow of water, and has particular reference to means adapted for reinforcing levees or the like, whereby it is impossible for such embankments to be damaged by the operations of musk rats or craw fish.

FLUME JOINT.—A. K. MITCHELL, care of Universal Metal Flume Co., Ltd., Box 301 Hamley Bldg., Victoria, B. C., Canada. The present invention is more particularly designed as a development of invention forming the subject matter of an application for patent on flumes, filed by Mr. Mitchell (Serial No. 708,-573), in which flume the overlapped ends of the flume sections are plain and without any bends or interlocking engagement, the sections being held solely by compression of the straps.

Hardware and Tools.

LAWN SPRINKLER.—B. F. CATHCART, 702 K St., Fresno, Cal. This sprinkler is so attached to the service pipe and to the box or housing that the water pressure will raise the sprinkler automatically, there being a novel form of closure, comprising two vertically rock-



LAWN SPRINKLER.

ing cover sections which are engaged by the sprinkler head or nozzle in its upward movement to open the closure, the arrangement being such that upon the withdrawal of the pressure and the consequent dropping of the nozzle or sprinkler, the cover sections will be automatically closed.

KETTLE TILTER.—J. EISHEN, JR., Kellogg, Minn. In this case the object is to produce a device so constructed that by the use thereof an ordinary kettle or other vessel having a lid may be readily and easily tilted and the contents discharged with but one hand and without danger of ever dropping or scalding in case the contents of the vessel to be drained are in a heated condition.

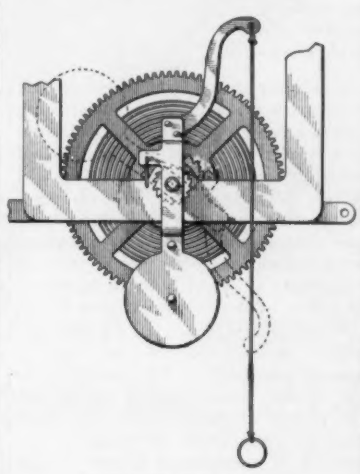
Heating and Lighting.

BOILER.—F. ELIZONDO, Contruas 28, Matanzas, Cuba. This boiler is more especially designed for use on locomotives and is arranged to provide a large heating surface to insure a rapid circulation of the water, and quick generation of steam, to avoid exposure of rivets to the heat of fuel in the fire-box and thus reduce leakage to a minimum, to permit easy cleaning of the boiler, and to avoid incrustation.

OIL BURNER.—C. F. POWERS, 517 N. 19th St., Birmingham, Ala. This device burns kerosene, gasoline or denatured alcohol with equal facility. The burner is simple in construction and provided with a heat retaining portion and a thinner heat conducting portion which may be readily heated to bring the fluid fuel to the vaporizing temperature.

Machines and Mechanical Devices.

CLOCK WINDING DEVICE.—C. T. BERNHARDT, Box 544, Salisbury, N. C. An object of this invention is to provide a clock-winding device in the form of a self contained unit attachable to the spindle of the winding barrel of the clock, and bodily removable there-



CLOCK WINDING DEVICE.

from when desired. By the special arrangement of a pawl, the attachment is adapted for employment either with a clock mechanism in which the spindle turns backward as the clock unwinds, or for mechanism in which the spindle remains stationary while the clock unwinds. The illustration shows a front elevation of a winding device, illustrating the same in connection with portions of a clock, including the spindle of the winding barrel.

SCALE ALARM.—W. J. RICE, Corpus Christi, Tex. The invention provides a simple, inexpensive, easily applied, and automatic device operated by the placing of the article to be weighed on the scales for indicating to the operator that the scales do not balance, or that it is out of poise.

HEEL SWEEP SETTER.—W. L. WILSON, P. O. Box 230, Stephens, Ark. This invention is an improvement in heel sweep setters, and provides a simple, easily operated device of the character specified, wherein mechanism is provided for receiving and holding a heated heel sweep and for shaping the sweep while held by the support.

KNITTING MACHINE ATTACHMENT.—N. D. BUCK, 169 Irving Ave., Brooklyn, N. Y. The present invention relates to a new and improved attachment for knitting machines of a type adapted to knit sweaters, whereby the speed thereof may be varied to allow for different conditions, such as plain or half-cardigan and racking stitches.

PAPER GAGE FOR TYPEWRITERS.—S. E. CAMPBELL, 304 W. 11th St., Grand Island, Neb. This invention has reference to attachments for typewriting machines and has particular reference to an attachment constituting indicating means whereby the operator may determine at a glance the position of the paper. The introduction of paper into the machine in a straight condition is facilitated.

LUG STRAP FOR PICKER STICKS.—W. N. KELLEY, 1850 Perkiomen Ave., Reading, Pa. The invention relates to looms and provides picker sticks arranged to insure a proper transmission of the power applied to the picker stick, to prevent accidental shifting of the lug strap of the picker stick, and to avoid weakening of the picker stick by holes, notches or the like.

ADJUSTABLE BEARING.—G. E. HESELTON, R. F. D. 4, Plattsburg, N. Y. The intention here is to provide a bearing for an anti-racing device, arranged to prevent racing when shifting from a heavy load to a light one or *vice versa*. For this purpose use is made of a base provided with a pin on which is mounted to slide a forked bearing by the use of a sleeve nut turned on the base and screwing on the forked bearing.

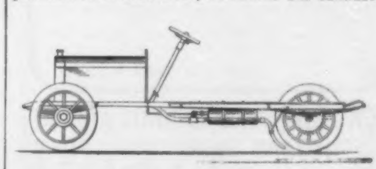
Pertaining to Recreation.

AMUSEMENT DEVICE.—H. F. MAYNES, 30 Atlantic St., Jersey City, N. J. For the purpose of providing a highly exhilarating and rather unsuspected ride use is here made of a slide and a starting chamber at the head of the slide, the chamber having a collapsible support for a person to occupy, and means for collapsing the said seat in the direction of the slide to cause the person occupying the seat to slide down off the support and down the slide.

Pertaining to Vehicles.

TRACTION ENGINE.—G. L. CAMPBELL and B. K. POSTLETHWAITE, care of the latter, 601 Oneida Block, Minneapolis, Minn. This invention provides an engine having a plurality of carrying wheels and a belt-like bed for increasing the ground surface contact; provides an engine with means for augmenting the traction pull of the driving wheels and with hauling devices; and provides a frame and supporting wheels therefor arranged to flexibly accommodate the wheels of the road bed, and to dispose the hauling strain directly upon the axles of the traction wheels.

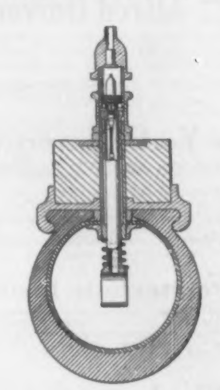
PNEUMATIC ANTISLIP DEVICE FOR POWER-DRIVEN VEHICLES.—B. DOUGLASS, JR., of Llewellyn Park, N. J., has invented and perfected an apparatus whereby a car can be instantly prevented from skidding without the aid of anti-skid chains or similar devices. By pressure on a foot lever, he makes the exhaust



PNEUMATIC ANTISLIP DEVICE FOR POWER-DRIVEN VEHICLES.

gases from the engine spread a sheet of sand in front, and on either side, of the drive wheels, so that the tires will be prevented from slipping sidewise or skidding. At the same time the gases are substantially muffled and silenced so that there is no objectionable noise as by throwing out the muffler. The roadway can be sanded exactly when and where needed. The apparatus is located in an inconspicuous portion of the frame and does not take up valuable storage space.

AUTOMOBILE TUBE AND TIRE SIGNAL.—J. E. FEATHERSTON, Valley City, N. D. This invention comprehends more especially an automobile wheel rim carrying a tire and having a tube extending radially through the rim, and a plunger fitted air-tight within said tube,



AUTOMOBILE TUBE AND TIRE SIGNAL.

and carrying a valve for retaining air in the tire, the plunger being movable relatively to the rim, under the rolling action of the wheel when the tire is deflated and uncontrollable by deflation of the tire for the purpose of actuating the signal.

Designs.

DESIGN FOR A SPOON.—S. H. ASHTON, Rhinelander, Wis. In this design for an ornamental and useful spoon, the article is gracefully designed and shows means for shielding the lips, moustache, etc., from the contents of the bowl.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

The Industrial Need of Technically Trained Men—III

Opportunities That Await the Trained Engineer

By. A. J. Himes, President of the Cleveland Engineering Society

[*THIS is the third of a series of monthly articles on the professional opportunities that await the technically trained engineer, physicist, chemist, bacteriologist, and technologist in modern life. The author of this article is peculiarly competent to speak on the subject. Since graduating from Cornell University as a civil engineer in 1887 he has had a wide experience in his profession. He is engineer of grade elimination of the N. Y. C. and St. L. R. R. Previously he was assistant chief engineer and before that bridge engineer of the Nickel Plate. He has been consulted on appraising the Michigan railways and estimating for water supply for New York city. He was assistant engineer to the United States Board of Engineers on deep waterways, and has served as resident engineer for the eastern division of the New York State canal. He was recently chairman of a sub-committee of the Cleveland Engineering Society on technical education in Cleveland, and made a report on technical education in the schools of Cleveland which has attracted considerable attention.*—EDITOR.]

An engineer should be a leader of men. He occupies of necessity a commanding position among his co-workers, and without a goodly supply of the qualities of leadership the highest success will not be reached. The times are rife with rebellious thought, and one who listens may come to think the exercise of authority a crowning sin. Children are not trained in obedience either at home or in school, and among adults the breaking of a rule or the evasion of a law is a gleeful adventure. Such conditions are born of ignorance and malice. It is impossible to erect a great steel building without the most perfect discipline among the workmen. No great effort involving the cooperation of a multitude of men can be successful without a clocklike organization and the faithful observance of orders by its every unit. But organization and discipline are not synonyms of despotism, and history shows that the greatest leaders have been both loved and revered by their men. It is needless to say that a small minded man of selfish aims and meanness of spirit would fail to qualify in this important particular for the life of an engineer.

In recent years the greatly increased popularity of technical and scientific education has produced such an influx to the ranks of the profession that talk of overcrowding is frequently heard. The profession has proved so attractive that persons whose motives seem purely mercenary have sought to stimulate the education of engineers.

But talk of overcrowding brings to mind the fierce labor riots along the Erie Canal during the early development of railroads. Graphic accounts of these disturbances are filed among the Assembly documents at Albany. Their origin was founded in the belief that the development of railroads would destroy the business of building canals and that there would be no work for the laboring men. Looking backward over the years of phenomenal railroad development and remembering the difficulty that has been experienced many times in securing a sufficient supply of labor, and that in spite of the rapid increase in population, one can hardly believe in the sanity of the advocates of such ideas.

The case of the engineering profession to-day is in a measure parallel to that of the canal builders. Having attained the summit of engineering achievement in the building of the Panama Canal, the pessimists whose peculiarities were so vividly described thousands of years ago in the book of Ecclesiastes, see only retrogression and decline. But engineering art is too young, too virile for such a fate. We have problems to solve which will cause the Panama Canal to occupy a much smaller portion of our field of vision than it does to-day. The regulation and control of the Mississippi River is such a problem. Our irrigation problems, the Salton Sea, the Grand Canyon of the Colorado River, afford opportunities for engineering works of the highest order. The improvement of transportation lines through cities, streams and mountains will call forth our utmost energy and skill. Water supplies and the sanitation of cities are of immediate necessity and it will be many, many years before our highways can attain a development comparable to those of the ancient Romans.

There are fashions in engineering as in spring hats. The popular mind does not seem capable of thinking calmly of more than one style at a time and suiting them to its needs. Just now reinforced concrete holds the stage. Stone masonry is a thing of the past. At one time canals were popular. Then came the railroads. Now better highways are much desired and canals are again looming in the distance. Locally there is difficulty in assigning proper relative importance to sewerage and water supply.

But of lack of engineering problems, there is none. It is not a case of lack of work, but how much work we can do. How soon will we be strong enough and skillful enough to undertake hopefully other and larger problems that will add still more to the delightfulness of the beautiful land in which we live.

He is a fortunate engineer whose early training and education has been planned with an eye to his future profession. Much of the fitness which a man may have for the work of his life is the result of early environment and training, a conspicuous fact in the lives of engineers. It has been commonly remarked that young men from the country display a superior aptitude for surveying. This is to be expected. The country boy has many opportunities to acquire a self-reliance and resourcefulness in his peculiar environment that are useful on extensive surveys. He learns to wield an ax or a saw, to outwit an angry bull or a vicious dog, to build a fire and to find his way through dense woods in the dark.

In the city this development is supplied to a degree and in some respects excelled by the training of the technical schools. It is essential that an engineer should be intimately familiar with the properties of structural material, and this knowledge he can gain in schools. He handles the iron at the forge and in the lathe and pours it molten from the furnace to the molds which he has made. He cuts the wood and fashions it into forms of which he has first made careful drawings. He does these things because of the pleasure he feels in building with his own hands, but at a later date, when called upon to construct great works, he uses the materials wisely because he knows them as friends. He knows their properties and capabilities, and putting them together, each in its proper place, there is produced a thing of strength and usefulness.

The studies which are peculiarly designed for the development of an engineer are mathematics and science. Of course there are others, but of these the nature is such that they are rarely pursued except at school, while descriptive texts can be read at any time. No boy who is to become an engineer can absorb too much algebra, geometry and physics unless it be to the exclusion of other knowledge.

There are varied lines of engineering work. In some, there is much to be done with a modicum of mathematics, in others there is need for much learning. So if there be much learning it will not lack a useful field, and if the learning be scanty there may still be a field of small dimensions and small reward.

There is competition among the colleges to see which one can publish the longest list of studies. It makes the poor boys dizzy and serves to befog the light. A few subjects carefully selected and thor-

INQUIRY COLUMN

READ THIS COLUMN CAREFULLY. You will find inquiries for certain classes of articles numbered in consecutive order. If you manufacture these goods write us at once and we will send you the name and address of the party desiring the information. There is no charge for this service. *In every case it is necessary to give the number of the inquiry.* Where manufacturers do not respond promptly the inquiry *may* be repeated.

MUNN & CO., INC.

Inquiry No. 9296. Wanted name and address of some glass manufacturing company who can make patent lamps.

Inquiry No. 9297. Wanted names and addresses of manufacturers of time saving household specialties goods.

Inquiry No. 9298. Wanted the name and address of a manufacturer of spun glass.

Inquiry No. 9298. Wanted the names and addresses of concerns who can turn irregular shaped handles in wood, similar to gun-stock work.

Inquiry No. 9299. Wanted name and address of the maker of a machine for driving fence posts into the ground.

Inquiry No. 9300. Wanted the name and address of a maker of a patented keyless door lock.

Inquiry No. 9301. Wanted the names and addresses of a few concerns who can do machine embroidery according to the design furnished, at reasonable rates.

Inquiry No. 9302. Wanted the address of the manufacturer of the Greenfield flexible armored conductors or cables. This is a double galvanized, spiral conductor or cable.

Inquiry No. 9303. Wanted the name of manufacturer who could make newly patented articles made from 13 to 22 gage sheet aluminum.

Inquiry No. 9304. Wanted the names and addresses of manufacturers of a second hand bag cleaning machine on the order of a carpet cleaning machine.

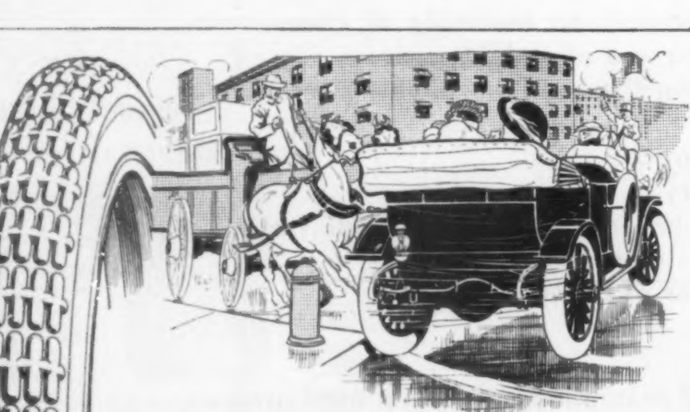
Inquiry No. 9305. Wanted the name and address of concerns making paper letters and figures.

Inquiry No. 9306. Wanted small hardware and other specialties to be sold in notion and grocery stores. Wanted to buy wholesale.

Inquiry No. 9307. Wanted to buy a machine for honing and stropping safety razor blades on a commercial scale.

Inquiry No. 9308. Wanted woven glass fabric for manufacturing purposes in large quantities. The glass is spun.

Inquiry No. 9309. Wanted to buy small woven tubing of small diameter for use over the temples of spectacles where they go around the ears.



oughly taught will do far more to develop a useful mind than the most elaborate curriculum hastily skimmed in the time allotted for a college course. It might prick the pride of a college president to know that his own institution had failed to cover the whole realm of human thought, but when more attention is given to the development of men and less thought to the making of encyclopedias, the beneficial effect will be quickly apparent. Surveying, hydraulics and applied mechanics are essential for an engineer. Geometry and drawing are taught in the high schools, but their study should be continued at college. Trigonometry must be learned from A to Z. It is the basis of a great variety of computations. If these subjects have been studied thoroughly under good teachers, the foundation for an engineering education has been laid. A completed education does not exist. A professional man must study always. In college his greatest need is to learn to study, to grow familiar with books and their use.

While the subjects already named are most directly useful in engineering, the benefits of a more general education must not be overlooked. Engineering is a learned profession, and its members must of necessity be well versed in a great variety of knowledge. In general and specifically he is charged with the practical application of natural science. Beyond that his relations with other men are such that a knowledge of logic and law are very helpful. He should be a good accountant and be familiar with the use of indexes and files.

There has been much discussion about the possibility of becoming an engineer without a college education. Some men have done so. A remarkable athlete can win a contest with a handicap, but most of us are glad to win with all the advantages possible. No better answer can be given.

Convention of the International Union for the Protection of Industrial Property

(*Concluded from page 436.*)

ton on June 2nd, 1911, has been ratified by the following governments: Austria-Hungary, Germany, Dominican Republic, Spain, United States, France, Great Britain, Italy, Japan, Mexico, Norway, Netherlands, Portugal, Switzerland, and Tunis.

It will be recalled that Article 18 of the convention provides that the ratifications of the adhering countries shall be deposited with the Department of State at Washington not later than April 1st, 1913, and that the convention shall be put into execution among the ratifying countries one month thereafter. The act with the final protocol replaces, in the relations of the countries which have ratified it, the convention of Paris, March 20th, 1883; the final protocol annexed to that act; the protocol of Madrid, April 15th, 1891, relating to the dotation of the International Bureau, and the additional act of Brussels, December 14th, 1900. The acts cited shall remain binding on the countries which have not yet ratified the Washington convention of 1911.

The ratifications of the countries mentioned having been now deposited in the Department of State, there are still remaining five governments adherent to the prior conventions which have not yet ratified the Washington convention. These countries are Belgium, Brazil, Cuba, Denmark, Sweden.

It is officially declared that the ratification for Austria-Hungary is effective with respect to Bosnia and Herzegovina, and the ratification of Great Britain relates only to the United Kingdom of Great Britain and Ireland.

At the conference of Washington, twenty nations other than those already mentioned were invited to participate in the deliberations with a view to become adherents to the Paris treaty of 1883 and its subsequent amendments. Up to the present time none of these non-adherent countries have signified their desire to become members of the International Union

for the Protection of Industrial Property. There is evidence, however, of an increasing interest on the part of non-adhering countries in the protection of industrial property, and by the time the next conference is held, it is expected that the union will be increased by further adherences. The next conference will be held at the Hague, the invitation from Queen Wilhelmina of the Netherlands having been announced at the Washington conference by her representative, M. Snyder-Van Wissenkerke, and unanimously accepted by the conference at its final session. The date for the next conference, however, has not yet been decided upon. Invitations thereto will be sent out from the bureau at Berne, as has been the case for former meetings.

Hints for Young Microscopists

(*Concluded from page 435.*)

shake so that they spoil the specimen. To make sections of epidermis and other large specimens requires that the specimen be hardened or imbedded in paraffin. To harden tissues, place them in absolute alcohol until they have acquired the proper degree of hardness, or soak them for a few days in a two per cent solution of bichromate of potassium. For imbedding in wax, the specimen should be hardened in alcohol and then surrounded with the wax mixed with a trifle of oil.

A sharp knife or, best, a razor blade should be used for cutting the sections. With a little practice, one can cut good sections with a razor blade, provided that they are cut under water. The simplest form of a microtome is shown in Fig. 2. *A* is a hollow cylinder, threaded at the lower end with a very fine thread. *C* is the adjustment screw for varying the thickness of the sections being cut. It is threaded to fit the cylinder, and when turned, pushes up the plunger, which in turn moves the specimen. *B* is a setscrew for making fast the specimen. The specimen to be cut is either placed in the tube *A*, loose and made firm with the setscrew, or it should be surrounded with wax by pouring the wax into the cylinder while the specimen is held in place. Plant stems can be cut in an excellent manner by the use of this simple microtome.

Bones, teeth, shells and all other hard substances require to be ground so thin that they can be examined by transmitted light before they are in a condition to be examined microscopically. With a finetoothed saw, as thin a section as possible is sawed off of the specimen. This section is now ground smooth on one side by rubbing it over a fine file or a piece of flat grindstone. After this has been done, the section is given a finer finish by grinding it with washed emery. As a finishing polish, it is polished with rouge. Now after the one side has been finished, this side will have to be cemented to a glass slide to permit the other side to be finished. For cementing it will be convenient to use Canada balsam. The section must be washed free from all grinding materials and must be thoroughly dry. So, too, the glass slide must be clean and dry. A drop of the balsam is put on the center of the slide and warmed until it runs and upon hardening becomes very thick. The section is now pressed firmly upon the balsam and the whole heated until the balsam becomes liquid again. Under no conditions must the balsam be boiled. Another glass section is placed on the section and clamped so that the bone is held tightly to the slide. It is then set away in a warm place for a few days to let the balsam become hard. The other side of the section is then ground in the same manner as was the first side, and a cover-glass is cemented on with balsam. The one thing to be careful of, is not to grind the section too thin. It should be frequently examined under the microscope, and as soon as a good section is obtained, the grinding should stop.

Most tissues are made to show their structure better by staining. The section is placed in the stain and left there a few seconds or even minutes until the stain has penetrated all through it. It is then

washed in distilled or sterilized filtered water to remove the excess of stain. If the section is to be mounted in an aqueous medium, the stain must be fixed so that it will not run. For Canada balsam mountings, most stains will not require fixing. When staining infusoria and rotatoria and other animalcules, the stain is put on the specimen by means of a dropper and left on for only a few seconds. If then the specimen is stained too deeply, it can be decolorized by immersing in alcohol. All animalcule preparations should be passed through the Bunsen flame five times before staining. This is to set the animalcules to the glass. The stains for staining vegetable tissue should contain from fifty to seventy-five per cent alcohol. The stains for animal tissues can be made like those for vegetable, but for pathological specimens where bacteria are looked for, the stains should be concentrated and double staining is required. The method of double staining will be described later. To mount the section, it is placed in a drop of balsam-xylol (xylol and balsam, q. v.), which has been previously placed upon the center of the slide. It may be left to advantage in this condition for a day, so that the balsam will have time to penetrate the air spaces. The slide, however, must be placed in a dust proof place. After the balsam has penetrated all the section, the slide is warmed until the balsam spreads freely, and a cover-glass is also gently warmed. The cover-glass is now lowered upon the section, care being taken to see that there are no air bubbles caught under it. A spring clip is now put on the mounting to hold the cover-glass tightly against the slide and specimen. A few formulæ for stains that are generally used for nearly all kinds of specimens are given below, so that the student may compound his own stains.

1.—Red Stain.

(*a*)	Carmine	1 part
	Ammonium hydroxide	1 part
	Distilled water	3 parts
(*b*)	Oxalic acid	1 part
	Distilled water	22 parts

To use: Take 1 part of carmine solution to 8 parts of acid solution and add 12 parts of alcohol. Filter. After staining, wash in 75 per cent solution of alcohol.

2.—A red, one-solution stain can be made by saturating ½ ounce of alcohol with carmine.

3.—Lilac color.

Borax	4 parts
Distilled water	55 parts
Dissolve and add carmine	1 part

Mix with twice the volume of absolute alcohol and filter.

4.—Violet stain.

Alcohol	1 part
Distilled water	1 part

Saturate with methyl-violet and filter.

5.—Acid carmine stain.

Mix ammoniacal solution of carmine with acetic acid in excess and filter. This is said to stain diffusely. If glycerine with muriatic acid (glyc. 200 and acid 1) is added, it concentrates all the color in the cell nucleus.

6.—For vegetable tissues.

(*a*) Haematoxylin .... 40 grains
Absolute alcohol ..... ½ ounce
(*b*) A solution of 4 grains of alum in 2 ounces of water.

To use: Add a few drops of *a* to a little of *b*.

Fresh membranes, if soaked in a solution of nitrate of silver (0.5 per cent to 1 per cent sol.), and washed, then exposed to the light, may show the mosaic epithelium.

Double staining is most used where the specimen contains bacteria. If such is the case, the following method has proved to be a reliable one. With a solution of gentian violet, the whole film on the cover-glass is first stained violet. Now, by immersing the cover-glass in a solution of iodine in iodide of potassium (iodine, 1 part; potassium iodide, 2 parts; water, 50 parts), the stain is fixed in the bacilli and not in the cells. The cover-glass is then washed and stained with a contrast stain.

For the beginner with the microscope,

there is a large field of objects that will be found interesting. For the infusoria, a wide mouthed bottle will be found quite sufficient. A conical net of muslin or linen will be needed for securing other animalcules that swim about in the different strata of water. To collect the infusoria, get some of the small weeds that grow on the bottom of a small ditch or pond. No doubt, there will be some of the tree-like colonies of the vorticella fastened to the weeds. You may also find other specimens of the rotifera and other polyzoa. The vorticella are to be looked for on the small green branches of the weeds and sometimes can be recognized with the naked eye. A collection of this sort can be kept in a small aquarium for several days. For securing the free-swimming animalcules, the net is swept through the water and then drained. Now it is carefully turned inside out, and the bottom gently rinsed in a wide mouthed bottle half filled with water. Also, a bottle may be lowered, inverted, into the water and at the right depth turned upright. This method of obtaining the animalcules will give a great variety of specimens of all sizes, including some kinds of bacteria. So we see that a small pond or ditch will afford nearly all the objects that are of interest to the beginner. As for getting plant stems and vegetable epidermis, the summer garden will have a good variety. Nearly all of the plants and vines that have ribbed stalks, exhibit a beautiful cell structure. Flies and insects are easily caught with a bag net and should be soaked for a few days in a five to ten per cent solution of potassium hydroxide before examining. Some vinegar contains minute worms which can be easily mounted. For the beginner the collection and preparation of objects will be found to be very interesting and will, no doubt, lead to the culturing of other micro-organisms that are not found in stagnant water.

Description of Plates.

Plate 1.—Implantation of hair in skin. Double staining. Balsam mounting. × 50.

Plate 2.—Section of the tongue. Methyl-violet staining. Balsam mounting. × 25.

Plate 3.—Section of the tongue showing the bare papillæ. Fuchsine staining. × 30.

Plate 4.—Section of vine stem, showing the annular cell structure. Glycerine media. × 25.

Plate 5.—Maxillary palpi of the tongue of the house fly. Balsam mounting after treatment with potassium hydroxide. × 40.

Engineering in the Alps

WORK is going on at present upon a tunnel through the mountains between France and Switzerland in order to give a more direct railroad connection. What is remarkable in this case is that unusually large quantities of water were met with, and the piping which had been laid in the tunnel was not sufficient to take care of the great outflow from the underground springs, so that the tunnel was flooded up to two feet height and quite a large cascade flowed out at the entrance. This also caused the neighboring springs to fall more or less. The somewhat curious result follows that an output of 100 to 250 gallons per second will be taken away from the basin of the Rhone or the French region and is now to be added to the Rhine basin in the Swiss region and thence to German territory. Owing to this unforeseen event, the expense of the work will be increased to a great extent, and the cost of the tunnel, reckoned at first at $3,500,000, will now be at least tripled. It is stated that but little previous work was done in the way of geological surveying, and this is now regretted. In fact, the accident occurred exactly at the point predicted by M. Fournier, professor of geology at the Besançon university, according to his examination of the geological conditions of the tunnel region.